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Bulletin 5

Stratigraphy and Paleontology of the
Brownsport Formation (Silurian)
of Western Tennessee

by

Thomas W. Amsden

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THOMAS W. AMSDEN

Published for Peabody Museum

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ABSTRACT

The Brownsport formation was named for Niagaran strata exposed in the vicinity of old Brownsport Furnace in Perryville quadrangle, Decatur County, Tennessee. It outcrops in Cheatham, Hickman, Lewis, Perry, Wayne, Hardin and Decatur counties of western Tennessee.

Lithologically this formation consists of about 100 feet of thin-bedded, argillaceous limestones and calcareous shales with lenses of thick-bedded, non-argillaceous limestone. The Brownsport formation is underlain by the Dixon formation with apparent conformity and overlain by the Decatur limestone with apparent conformity.

Previous workers have subdivided the Brownsport into three formations or members, but the present investigation does not reveal any satisfactory lithologic or faunal basis for this division.

The Brownsport strata are richly fossiliferous in most localities and extensive collections have been made. This report includes a study of the brachiopods, crinoids, cystoids, blastoids and corals.

The Brownsport formation is correlated with the Bainbridge limestone of Missouri, Louisville limestone of Kentucky, Henryhouse shale of Oklahoma, and with certain Niagaran dolomites in the Chicago area. Correlations with other formations have not been definitely established.

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STRATIGRAPHY AND PALEONTOLOGY OF THE BROWNSPORT FORMATION (SILURIAN) OF WESTERN TENNESSEE

INTRODUCTION

The Brownsport formation was named for Silurian strata exposed around old Brownsport Furnace in the southeastern part of Perryville quadrangle, Decatur County, Tennessee (map, fig. 1).^{*} Lithologically it consists largely of thin-bedded, argillaceous limestones and calcareous shales which overlie the Dixon red limestones and shales and underlie the Decatur limestone. In the western part of Tennessee it forms numerous exposures along the Tennessee River Valley in parts of Wayne, Hardin, Perry and Decatur counties.

The Brownsport formation has been known for over 100 years as a source of numerous, well-preserved Silurian fossils. Several geologists including Roemer, Safford, Foerste and Springer have described portions of the fauna but no systematic paleontological study has been made; furthermore, the stratigraphic sequence has never been satisfactorily presented. The present work was undertaken to make a detailed stratigraphic and palaeontological study.

The results of this work on the stratigraphy and on that part of the fauna which includes the brachiopods, crinoids, cystoids, blastoids and corals appear in this paper.

The field work for this report was done during June of 1942 and August and September of 1946. The area studied comprises those parts of Decatur, Perry, Wayne and Hardin counties shown on the map, figure 1. This region is one of gently rolling hills with only a few hundred feet of relief. More than half of the surface is covered with woods, and outcrops of bed rock are somewhat scattered. Complete sections of the Brownsport formation are rather rare, as the formation is one with relatively little resistance to erosion, the argillaceous limestones and shales weathering easily into clay-covered slopes called glades (figs. II, III).

Most of the exposures which show the entire Brownsport formation are found in the bluffs along the Tennessee River but a few of the larger tributary streams such as the Buffalo River have bluffs of sufficient height to give good sections.

In the course of this work 53 sections were measured and extensive fossil collections were made. Since the Brownsport formation decomposes so readily, many of the fossils were collected loose on the surface. In every case, however, collections were made on measured sections so that the stratigraphic position could be ascertained as closely as possible. Each section that was measured has been given a number (1 to 53 on the map, fig. 1). A fossil

^{*} This map was compiled from the latest maps available to the author; since these maps were made, a new T.V.A. dam has been completed and the river has risen, flooding some of the roads near the river.

lot collected from a section was given the number of that section to indicate its geographic position; its stratigraphic position is indicated by a sub-number in parentheses which follows the section number (e.g., 4-(29); 30-(78). The stratigraphic position of each of these sub-numbers, as well as the geographic position of each of the section numbers is given on pages 37-41 of this report.

The writer wishes to acknowledge the assistance of Professor C. O. Dunbar, who spent a part of each field season in the area and gave valuable suggestions and criticism on all parts of the work. Dr. G. A. Cooper of the United States National Museum offered much helpful criticism on that part of the paper dealing with the brachiopods, and Professor H. E. Vokes made numerous constructive suggestions. The writer is indebted to the National Research Council for financing the last ten months of work and to the Department of Geology at Yale University which helped defray the expenses of the 1942 field season. The courtesy of the Tennessee Geological Survey in furnishing United States Geological Survey and Tennessee Valley Authority maps of the area is much appreciated.

This study was presented as a dissertation for the degree of Doctor of Philosophy at Yale University in May, 1947.

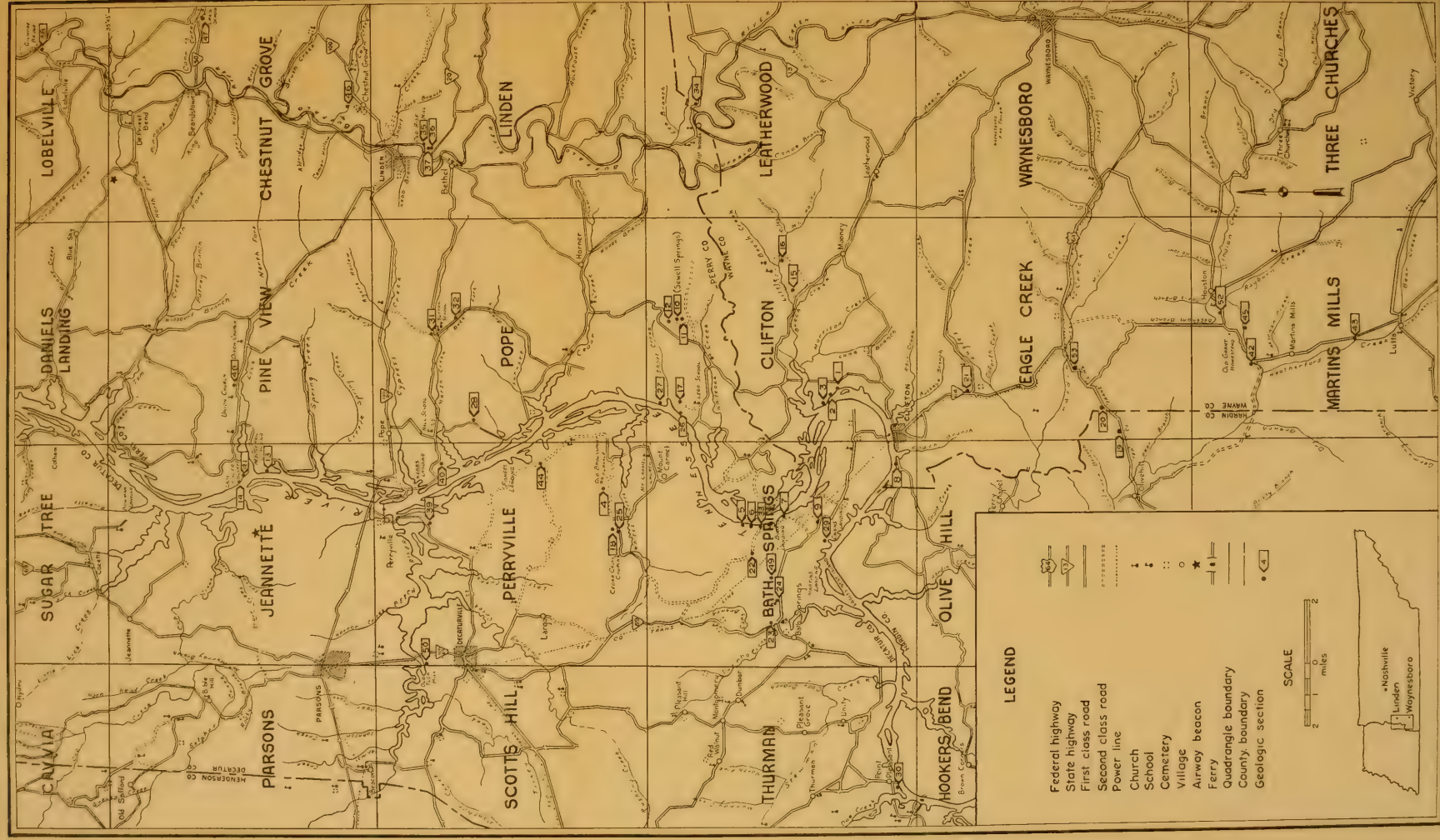


Figure 1. Map showing location of geologic sections.

SUMMARY OF PREVIOUS INVESTIGATIONS

There was no stratigraphic study of the Brownsport formation prior to 1861 although several fossil collections were made and a part of the fauna was described. In 1835 Troost described a blastoid, *Pentremites* [*Troosticrinus*] *reinwardti*, which he found associated with *Calceola sandalina* [*Rhizophyllum tennesseense*]. These were found in "Perry County, Tennessee, about two miles west from [the] Tennessee River, imbedded in an argillaceous limestone containing here and there green earth, which renders this rock susceptible of disintegration" (1835, p. 225).

Troost wrote other papers of this nature, among which was a manuscript on Tennessee crinoids sent to the Smithsonian Institution in 1850. This paper, which contained a description of several species from the Brownsport beds, was never published until Wood (1909) presented a summary of it under the title *A Critical Summary of Troost's Unpublished Manuscript on the Crinoids of Tennessee*.

Roemer in 1860 published a monograph on a part of the Brownsport fauna, including a description of 58 species and 5 plates of illustrations. He collected this material in 1847 from Perry and Decatur counties, working on both sides of the Tennessee River, from a point 5 miles north of Brownsport Furnace to Perryville. No stratigraphic location was given other than that the collections came from the glades of this area (1860, pp. v-vii).

The first published description of the Silurian strata in this area was given by Safford in 1861 (pp. 205-209). He presented the following stratigraphic sequence for the vicinity of Clifton

8. Strata (when weathered) bluish or greenish siliceous shale. Eight feet at the base interstratified with thin, smooth, fine-grained sandstones which are charged with *Lingula*.

Devonian.

7. Fine-grained sandstone highly charged with the same *Lingula* as above.

8'

Upper Silurian

6. Gray, crinoidal limestone—Fossils obscure at this point—the horizon, however, of well marked Lower Helderbergian rocks at other points in Wayne County.

25'

5. Glade-forming limestones and calcareous shales—the limestones gray often coarse crinoidal—sometimes argillaceous—all very fossiliferous—occasionally containing layers of chert.

90' Meniscus beds

4. Variegated limestone; brownish-red and gray layers interstratified—many layers argillaceous—*orthocera* abundant in lower part.

96'

Hudson River.

3. Greenish calcareous shale.

Safford gave the name Meniscus beds to the glade-forming limestones and calcareous shales of unit 5 because the sponge *Astraeospongia meniscus* was so common in them. His description and the thickness of these beds seem to indicate clearly that they are equivalent to what is now called Brownsport (fig. 4). From his remarks on bed 6 it seems probable that he included the Decatur limestone with the Lower Devonian limestones. This is further supported by the fact that his thickness for the Meniscus beds (90 feet) is approximately correct for the Brownsport beds but is not sufficient for the combined Brownsport-Decatur. His variegated limestone unit (No. 4) has been subsequently broken down into the following formations: Dixon, Lego, Waldron, Laurel, Osgood and Brassfield.

In *Geology of Tennessee* Safford (1869, pp. 311-312, 316) repeated the section shown above but this time he included the variegated beds in the Meniscus limestone, although he noted that *Astraeospongia meniscus* was characteristic only of the upper, glade-forming limestones (fig. 4). Safford and Killebrew in 1876 (pp. 108, 142-146; 1900, pp. 104, 133-135) changed the name Meniscus to Clifton limestone, named for exposures in the vicinity of Clifton, Tennessee.

Foerste (1903, p. 566) subdivided the variegated beds of Safford into several formations, with the Dixon red clays and limestones at the top (fig. 4). For the overlying Silurian beds he proposed the term Brownsport formation, named for Brownsport Furnace. Foerste's description of this formation is as follows: "Above the Dixon red clay is a section of white limestones and clays, exceeding 100 feet in thickness. This section is often richly fossiliferous and contains the fauna studied by Roemer during his three weeks' visit to Decatur County, Tennessee. To this section overlying the Dixon red clay the name Brownsport is here given" (1903, p. 566). His Brownsport formation included what is now called the Decatur limestone (1935, p. 180).

Foerste could have used the term Clifton limestone instead of Brownsport, but this would have meant a considerable restriction of Safford's original definition and he evidently thought it would be less confusing to use a new name.

Foerste examined Safford's section (1869, p. 326) in the vicinity of the old Gant homestead, located in the northern part of the Martins Mills quadrangle. In the upper part of the Brownsport of this area he found a 5 to 10 foot bed of coarse-grained, sandy (?) limestone which he called the Gant limestone. Above the Gant limestone and below the Hardin sandstone were thinner-bedded, poorly exposed limestones (the Decatur being absent in this area). The term Gant beds was applied to the Gant limestone and the succeeding part of the Brownsport formation (1903, pp. 576, 583). Below is the section given by Foerste at Martins Mills, two miles south of the Gant place. The Gant beds were recognized only in the Martins Mills area.

Hardin sandstone.

Brownsport formation,

Gant beds.

14'—limestone, much weathered and poorly exposed.

9'—bluish, better bedded limestone, partly fine-grained and partly crinoidal.

5'—sandy Gant limestone.

57'—whitish clays and soft limestones.

Dixon beds.

A list of the Brownsport fossils was included in this paper (1903, pp. 708–714), but no descriptions or figures were given. In 1909(B) Foerste wrote a paper entitled *Fossils from the Silurian Formations of Tennessee, Indiana and Illinois* which included descriptions and illustrations of a number of Brownsport fossils.

Pate and Bassler published a joint study of the Brownsport formation in 1908. This was based upon several seasons of collecting by Pate and two weeks spent in the area by both men during 1907 (1908, pp. 407, 409). In this publication they proposed to separate the upper thick-bedded, gray limestone from the Brownsport and call it Decatur. The Brownsport was elevated to the rank of a group and divided into three formations with the Beech River at the base followed by the Bob and Lobelville (fig. 4). Each of these formations was believed to be separated from the other by an unconformity.

Their type section for the Decatur limestone is at Tuck's Mill, north of Decaturville (section 50 of this report). No section was given at Tuck's Mill but they did give a composite section which was compiled from various exposures in the vicinity of Decaturville. The Beech River formation was named for exposures along Beech River, the type section being located about a mile and a half south of Perryville (section 39 of the present report). The Bob formation was named for Bob's Landing on the west bank of the Tennessee River, Bath Springs quadrangle (Section 33 of this report). Pate and Bassler considered the Bob formation equivalent to the Gant beds of Foerste (including the Gant limestone at their base), but they did not use the term Gant formation because the exposures at the Gant place were poor and because it was difficult to find since Gant no longer lived there.

The uppermost division proposed for the Brownsport group was the Lobelville, named for exposures in the vicinity of Lobelville (section 38 of this report). No section was given near Lobelville but sections of the formation were made at Peeler's Pond and at Rise Mill.

Pate and Bassler stated that these divisions were well marked lithologically and faunally but a careful examination of the type sections and other sections as described by these authors does not reveal any consistent lithologic distinctions among them. All three consist of thin-bedded, argillaceous limestones and shales, the Bob having in addition varying amounts of thicker-bedded, non-argillaceous limestone. As defined by Pate and Bassler

	Safford 1861	Safford 1869	Safford & Killebrew 1876, 1900	Foerste 1903	Pate & Bassler 1908	Compilation Dunbar 1919, Miser 1921, Jewell 1931	Amsden 1948
Carb. or Devonian	Shale Sandstone	Shale Sandstone	Shale Sandstone	Shale Sandstone	Shale Sandstone	Shale Sandstone	Shale Sandstone
Lower Devonian	Gray, crinoidal limestone Probably included Decatur limestone with above	Gray, crinoidal ls.	Linden limestone	Lower Devonian strata	Lower Devonian strata	Lower Devonian strata	Lower Devonian strata
Silurian	Meniscus beds Glade-forming limestones and shales. Fossiliferous 80'-100'	Meniscus limestone	Sponge-bearing bed 90'	Brownsport formation 120' Gant ls. } Gant beds } Recognized } only in the } Martins Mills } area; Decatur } absent here	Brownsport group 257' Lobelville 76' Coral zone unconformity Bob 75' Dictyonella zone unconformity Beech River 106' 6" Eucalyptocrinus zone Troostocrinus zone Coccocrinus zone	Brownsport formation Lobelville member (shaly limestone and shale) 0 - 100' Bob member (massive limestone) 0 - 75' Beech River member (shaly limestone and shale) 0 - 106'	Brownsport formation 95' - 116'
	Variegated limestone 96'	Variegated limestone 96'	Variegated limestone 100'	Dixon Lego Waldron Laurel Osgood Clinton	Dixon Lego Waldron Laurel Osgood "Clinton"	Dixon Lego Waldron Laurel Osgood Brassfield	Dixon Lego Waldron Laurel Osgood Brassfield
			Clifton limestone				
			Sponge-bearing bed 100'				
Ordovician							

Figure 4. Chart summarizing the results of investigations on the Brownsport formation.

these divisions were really based upon fossil content and should more properly have been called faunal zones (but, as explained later, they actually represent faunal facies rather than zones). According to them the Beech River formation furnishes "most of the crinoids of the late Niagaran of West Tennessee" (1908, p. 418). The Bob contains "all of the brachiopod bearing strata" (1908, p. 421) and the Lobelville is "characterized paleontologically by a fauna of corals so abundant in species and specimens that the identification of the beds is attended with little difficulty" (1908, p. 422). No paleontological descriptions or illustrations were included in this paper but some faunal lists were given.

The total thickness reported by these authors for the Brownsport group is 257 feet; but this is a composite thickness, the thickest section measured being 109 feet at Brownsport Furnace.

The conclusions reached in this present study do not agree with this interpretation of the Brownsport given by Pate and Bassler. The writer believes that the thickness of 257 feet is much too great, the true thickness being 100 to 120 feet. Furthermore there does not appear to be any firm lithologic or faunal basis for a three-fold subdivision of the formation. A more detailed examination of these differences will be presented after the stratigraphy and faunal distribution have been discussed.

In 1920 Springer published his monograph, the *American Silurian Crinoids*. Many of the species described in that report were collected from the Brownsport formation by Pate. In the summers of 1906 and 1907 the latter, under the direction of Springer, undertook extensive quarrying operations in the Brownsport formation along Beech Creek. The purpose of this work was to obtain well preserved crinoid specimens and its success is amply demonstrated by the numerous Brownsport species illustrated in the monograph. Springer followed Pate and Bassler in regarding the Brownsport as a group with three well-marked faunal zones.

Later workers have accepted Pate and Bassler's removal of the Decatur limestone from the Brownsport. The subdivision of the Brownsport into three units has also been followed but the attempt has been to establish these upon a lithologic basis (fig. 4).

Dunbar (1919, p. 12) described the Beech River and Lobelville formations as consisting of thin-bedded, shaly limestones and shales separated by the Bob formation of pure, massive limestone with some variegated shales. Subsequent workers have regarded the Brownsport as a formation divided into three members and this system of classification is used by the United States Geological Survey (Wilmarth, 1938, p. 276).

Miser (1921, pp. 16, 21) described the three members of the Brownsport formation as follows: Beech River member consisting of shaly, greenish-gray or yellowish-gray limestones and greenish and purplish shales, 0-84 feet thick; Bob member consisting of massive, coarsely-crystalline limestone with some thin-bedded chert, 0-35 feet thick; Lobelville member of gray, shaly limestone and yellowish shale, 0-100 feet thick. Jewell's description (1931, pp. 23, 29-31) is much like that of Miser although he regarded the Lobel-

ville as being cherty. According to him the maximum thickness of the Brownsport formation in Hardin County is 105 feet, with the Beech River varying from 0-45 feet, the Bob from 0-20 feet and the Lobelville from 0-40 feet. He also states (1931, p. 31) that the "Lobelville limestone overlies the Bob conformably and is conformably overlain by the Decatur limestone."

The geological section of the Brownsport formation given by Ball (1941, p. 1120) is much like that of the authors mentioned above and his thickness the same as that of Pate and Bassler. C. W. Wilson, Jr., has mapped the area that includes the Brownsport beds. His study has not yet been published but he has told the writer that he has mapped the Beech River, Bob and Lobelville as separate units.

A brief recapitulation of the preceding pages shows that the Brownsport was named by Foerste for those Silurian strata lying above the Dixon red limestones and shales. Pate and Bassler subdivided this formation into two units, the upper called the Decatur limestone and the lower the Brownsport group. The Brownsport group was further subdivided into the Beech River, Bob and Lobelville formations, based largely upon faunal characters. Most later workers have regarded these three units as members and attempted to establish them upon a lithologic basis. According to these investigators the Beech River and Lobelville consist of thin-bedded, argillaceous limestones and shales with varying amounts of chert, separated by the Bob limestone.

STRATIGRAPHY

GENERAL DISCUSSION

The Brownsport is recognized in this report as a distinct formation which overlies the Dixon formation with apparent conformity and is overlain by the Decatur limestone with apparent conformity. It consists of thin-bedded, commonly nodular, argillaceous limestones with some calcareous shales in beds ranging up to 4 or 5 inches in thickness. The amount of shale varies greatly but where the strata are exposed in a relatively fresh condition it is usually seen to be subordinate to the limestone. In some places the limestones consist of 1 to 4 inch beds of gray, medium- to coarsely-crystalline limestone separated from one another by clay seams. In other places the clay is dispersed through the limestone, and as the amount of clay increases the limestone grades over into calcareous shale. Chert may be locally present but is commonly not conspicuous; it is generally more common in the upper part of the formation and at location 13 north of Perryville is quite abundant in the upper 24 feet. The color of the formation is variable but is commonly a greenish- to yellowish-gray. The lower 15 to 20 feet is often mottled with red and in some localities has a definite purple color. Locally it includes lenses of thicker-bedded, gray limestones in which the beds range up to 4 feet in thickness and which are generally quite free of argillaceous material.

The argillaceous limestones and calcareous shales of the Brownsport formation disintegrate rather easily to form clay-covered slopes and mounds which are called glades (figs. II, III, V). These glades are relatively free of vegetation, bearing only scattered clumps of grass and a few stunted cedar trees. Their surfaces are generally littered with a rubble of small limestone fragments which represent the more resistant parts of the formation. Fossils also weather out free on the surface and in some glades are so numerous that, together with the limestone rubble, they almost cover the surface. At scattered intervals the glade surface is broken by outcrops of thin, nodular-bedded, argillaceous limestones and shales. Such ledges vary in thickness from less than a foot up to several feet and generally do not persist for any great distance along the strike. The upper part of the Dixon red limestones and clays has a similar tendency to disintegrate and commonly the lower margin of the glade is colored red, this red representing weathered Dixon and being in sharp contrast to the greenish to yellowish-gray color of the Brownsport.

The thickness of the Brownsport remains relatively constant over the area studied. Measurements of the complete formation range from a minimum of 95 feet in the vicinity of Perryville (location 39) to a maximum of 116 feet in the Jeannette quadrangle (location 13). Figure 6 presents in columnar form the most complete and best exposed sections studied.

UNDERLYING DIXON FORMATION

The contact between the Dixon and Brownsport is well defined and may be easily located throughout the area studied. The Dixon formation consists of brick-red, fine-grained, argillaceous limestones and clays which are locally mottled with green. The limestones show rather uniform bedding and range up to 2 feet in thickness. The Dixon red color is quite persistent in the area studied but is lost towards the east and southeast (Foerste, 1903, p. 568; Miser, 1921, p. 21). Section 37 at Rise Mill (Linden quadrangle) is the only place where the Dixon was observed without its red color. Here the upper part of the formation consists of greenish-gray, earthy limestones and clays whereas the overlying Brownsport strata are composed of argillaceous limestones and shales which have thinner and more nodular beds than the Dixon.

The upper 18 inches to 2 feet of the Dixon formation is a brick-red clay. The base of the Brownsport includes about 2 feet of greenish-gray clay which is followed by thin-bedded, greenish-gray, argillaceous limestones and calcareous shales, locally mottled with red. There is an excellent exposure of this contact in the northern part of the Martins Mills quadrangle (fig. vii). Here the uppermost Dixon beds consist of 2 feet of red clay followed by 18 inches of green clay which forms the basal bed of the Brownsport. Above this lies thin-bedded, argillaceous limestone with a greenish-gray color. The contact is well exposed for several hundred feet and appears to be conformable.

The contact is also well exposed in many other parts of the area and shows this same lithologic sequence with no evidence of unconformity. This contact is the same as that used by Foerste and later workers and is probably the one drawn by Safford between the variegated limestones and the sponge-bearing beds (fig. 4).

OVERLYING DECATUR FORMATION

The Brownsport formation is overlain with apparent conformity by the Decatur limestone. This formation consists of gray, medium- to coarsely-crystalline limestone in beds ranging from 6 inches to 2 feet in thickness (fig. viii). Lithologically it is distinct from the Brownsport formation in that it is more massive-bedded and is not argillaceous.

The Decatur-Brownsport contact is well exposed at several places in the area studied, one of the best being at old Tuck's Mill north of Decaturville (location 50). Here the Decatur consists of thick-bedded, gray, medium- to coarsely-crystalline limestone and the Brownsport of thinner-bedded, argillaceous limestones and shales. Pate and Bassler believed that at this locality the Decatur rests unconformably upon the "Beech River formation" but we were unable to detect any evidence of unconformity. The contact is well exposed for several hundred feet and a careful examination shows every appearance of a conformable relationship.

Another excellent place to see the Decatur-Brownsport contact is at loca-

tion 14 in Jeannette quadrangle. Here the Brownsport beds consist of thin-bedded, yellow- to greenish-gray, argillaceous limestones and calcareous shales overlain by thicker-bedded Decatur limestone (figs. ix, x). The contact is exposed for several hundred feet and appears to be conformable.

In some parts of the area studied the Decatur may be overlain by Devonian limestone. There is a good example of this in a quarry on state highways 69 and 100 about a half mile east of old Tuck's Mill. Here the Decatur limestone bearing *Eucalyptocrinites* and *Pisocrinus* was found to be overlain by a limestone which carries fossils of Lower Devonian age. The two limestones are, however, very similar in appearance and the writer was unable to locate the exact contact on the basis of lithology.

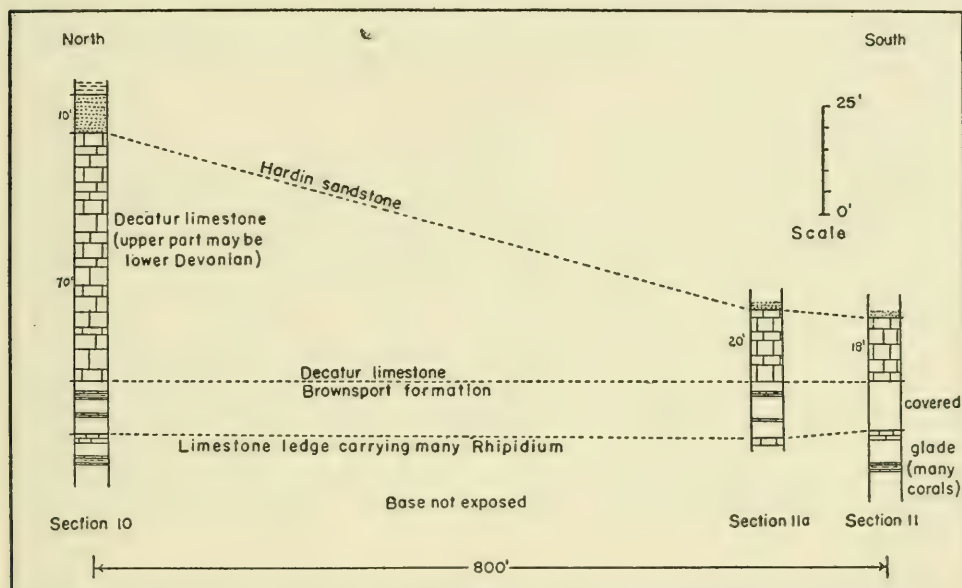


Figure 11. Sections near Sewell's Spring showing post-Silurian unconformity.

This same relationship was found to exist at locality 31 (Pope quadrangle) where limestones carrying Devonian fossils were found to overlie the Decatur limestone containing such fossils as *Trigonirhynchia tennesseensis*, *Wilsonella saffordi* and *Leptaena tennesseensis*.

Devonian limestones also overlie the Decatur at section 38 (Lobelville quadrangle) and in the vicinity of Perryville (Dunbar, 1919, p. 35, fig. 5).

A post-Decatur unconformity is present throughout the area studied so that the Decatur may be overlain by beds ranging in age from Devonian to Cretaceous (Jewell, 1931, p. 31). On account of this post-Silurian erosion the thickness of the Decatur varies greatly within short distances. This is well shown at Sewell's Spring, in Clifton quadrangle, where the Decatur varies in thickness from 70 feet at location 10 (possibly some Devonian limestone in the upper part) to 18 feet at location 11 as shown in figure 11.

In many parts of the area the Decatur is absent, as at old Rise Mill, Linden quadrangle (location 37) where the Brownsport beds are directly overlain by Chattanooga shale with the Hardin sandstone at its base. The same relationship exists at location 34 (Leatherwood quadrangle) and in the northern part of the Martins Mills quadrangle (fig. XII).

BROWNSPORT FORMATION

GENERAL DESCRIPTION. At the type locality of the Brownsport, near old Brownsport Furnace (section 4 of this report), the formation forms two glades, a southern one which exposes the lower 25 feet of beds and a northern one exposing about 60 feet of higher strata (figs. III, V). The Dixon-Brownsport contact is well exposed, the uppermost Dixon bed consisting of a foot or so of red clay followed by the Brownsport strata as shown below:

Brownsport formation.

Covered; top of formation not exposed.

- 29' Glade with a few outcrops of yellow clay and argillaceous, yellow to buff limestones. In the upper 5' of this glade brachiopods are common, the following species present: *Parmorthis brownsportensis*, *Sieberella roemeri*, *Strophonella prolongata*, *Fardenia roemeri*, *Leptaena tennesseensis*, *L. delicata*, *Camarotoechia acutiplicata*, *Atrypa tennesseensis*, *A. arctostriata*, *Merista tennesseensis*, *Homoeospira elongata*.

This glade also carries the following corals: *Favosites louisvillensis*, *F. brownsportensis*, *F. clavatus*, *F. beechensis*, *Heliolites tennesseensis*, *Dendropora?* *culmula*, *Ditoecholasma fanninganum*, *Enterolasma waynense*, *Anisophyllum agassizi*, *Amplexus brownsportensis*, *Cyathophyllum angulare*, *Naos brownsportensis*, *N. sewellensis*.

- 4' Thin, nodular-bedded, greenish-gray limestone. *Lyonicrinus bacca* collected here.
- 28' Greenish-gray, argillaceous, nodular-bedded limestone with some clay; upper 14' is largely glade. Carries *Parmorthis brownsportensis*, *Mendacella cliftonensis*, *Isorthis arcuaria*, *Schizoramma fissiplica*, *Sieberella roemeri*, *Strophonella prolongata*, *Leptaena tennesseensis*, *Camarotoechia perryvillensis*, *C. acutiplicata*, *C. cedarensis*, *Wilsonella saffordi*, *Atrypa tennesseensis*, *A. arctostriata*, *Merista tennesseensis*. *Homoeospira elongata* and *H. schucherti*.
- 24' Partial glade; outcrops of fine-grained, argillaceous limestone in nodular beds to 4". The following species collected here: *Troosticrinus reinwardti*, *Rhizophyllum tennesseense*, *Ditoecholasma fanninganum*, *Enterolasma waynense*, *Parmorthis brownsportensis*, *Isorthis arcuaria*, *Schizoramma fissiplica*, *Sieberella roemeri*, *Leptaena tennesseensis*, *Trigonirhynchia tennesseensis*. *Atrypa tennesseensis*, *Merista tennesseensis*.

Dixon red limestones and clays.

As shown above the upper part of the Brownsport is now covered and therefore it was not possible to get the complete thickness or to determine the overlying strata. The exposures were evidently better when Foerste was

in this area for he found 120 feet of Brownsport beds with the Chattanooga shale exposed "by excavations for ore along the hillside northwest of the old Furnace" (1903, p. 573). This is probably due in part to the fact that the excavations made in the course of the mining operations were much fresher at that time.

Pate and Bassler (1908, p. 413) also examined the section at Brownsport Furnace where they found 109 feet of Brownsport beds exposed. They describe the strata as consisting of argillaceous limestones and shales, which agrees in general with the writer's observations although it was not possible to correlate the individual zones with those given by them. They recognized their "Beech River," "Bob" and "Lobelville" formations but neither their description nor the writer's field observations show any lithologic basis for such a division. As noted before, these authors really based their divisions upon the fauna, the "Beech River" being characterized by *Eucalyptocrinites*, *Coccocrinus* [*Lyonicrinus*] and *Troosticrinus*; the "Bob" by a brachiopod fauna and the "Lobelville" by a coral fauna. The writer's observations do not support this idea of faunal distribution. As may be seen from the above section the brachiopods are perhaps most numerous in a zone 24 to 52 feet above the base, but they are also well represented in the lower part of the formation where they are associated with *Troosticrinus*, and also in the highest strata exposed where they are associated with a rather abundant coral fauna. The crinoids are extremely rare, the only species collected being *Lyonicrinus bacca*. A more detailed analysis of the faunal distribution will be presented later.

The type locality for Pate and Bassler's "Beech River" formation is about a mile and a half south of Perryville (section 39 of this report). The entire Brownsport formation is present here and forms a glade, with the Dixon beds underlying it and the Decatur limestone above as shown in the section below.

Decatur limestone.

Medium- to coarsely-crystalline, gray limestone in beds to 3'.

Brownsport formation.

22'—Glade; a few outcrops of argillaceous limestone and shale in the upper part.

Only sparingly fossiliferous with the following species represented: *Parmorthis brownsportensis*, *Eucalyptocrinites ventricosus*, *Lecanocrinus pisiformis*, *Astracospongia meniscus*, *Caryocrinites milliganae*, *Striatopora gwenensis*.

2'—Thin-bedded, nodular, greenish-gray, argillaceous limestone.

34'—Glade with a few scattered outcrops of argillaceous limestone and calcareous shale. There are a great many *Astracospongia* here in addition to the following: *Eucalyptocrinites ventricosus*, *Pisocrinus quinquelobus*, *P. campana*, *Caryocrinites milliganae*, *Troosticrinus reinwardti*, *Parmorthis brownsportensis*, *Isorthis arcuaria*, *Schizoramma fissiplica*, *Leptaena tennesseensis*, *L. delicata*, *Trigonirhynchia tennesseensis*, *Atrypa tennesseensis*, *Favosites discoideus*, *Naos brownsportensis*.

3'—Greenish-gray, argillaceous limestone.

34'—Largely glade with only a few outcrops of argillaceous limestone and calcareous shale. Crinoids are common with the following species represented: *Cytocrinus laevis*, *Eucalyptocrinites ventricosus*, *Lyonocrinus bacca*, *Lecanocrinus pisiformis*, *Pisocrinus campana*, *P. quinquelobus*, *P. tennesseensis*, *P. sphericus*, *Myelodactylus ammonis*. *Caryocrinites milliganae*, *Troosticrinus reinwardti* and *Astraeospongia* are also present in addition to the following brachiopods: *Parmorthis brownsportensis*, *Isorthis arcuaria*, *Schizoramma fissiplica*, *Strophonella laxiplicata*, *Leptaena tennesseensis* and *Atrypa tennesseensis*. The corals *Enterolasma waynense* and *Ditoecholasma fanninganum* are common in this zone along with a few specimens of *Rhizophyllum tennesseense*, *Favosites clavatulus*, *Dendropora?* *culmula* and *Thecia minor*.

2'—Soft, light-green clay.

Dixon red limestones and clays.

At this locality Pate and Bassler (1908, p. 418) found 74 feet of strata present with the overlying beds covered by loose blocks of Decatur limestone. They referred all of this to the "Beech River formation" and thought that the upper part of the Brownsport represented by the "Bob and Lobelville" was absent. Their observations on the lithology do not differ materially from those given in this report although they did find somewhat more shale than is thought to be present. The writer was able to locate the contact with the overlying Decatur within a few feet and finds the Brownsport formation to have a total thickness of 95 feet, which does not differ significantly from the thickness found at other localities in the area studied. The brachiopods and corals are not as numerous here as at other localities but this is the result of facies variation, a matter that will be discussed later.

Glade sections such as those at Brownsport Furnace (section 4) and Perryville (section 39) are excellent for purposes of collection but are not the best places to see the lithologic sequence, since the strata are partially decomposed and part of them are covered. Such outcrops are well supplemented by the river-bluff sections which give a better exposure of the lithology but which are not as suitable for purposes of collection.

Mousetail Bluff on the east side of the Tennessee River in Jeannette quadrangle (section 13) gives a fairly complete exposure of relatively fresh Brownsport strata as shown below:

Decatur limestone.

Medium- to coarsely-crystalline limestone in beds to 3'.

Brownsport formation.

24' Buff limestone with numerous chert lenses; beds ranging from 2 to 4" in thickness. This limestone is in part argillaceous and in part non-argillaceous.

27' The lower 16' of this interval is largely covered, with only a few outcrops of argillaceous limestone. The upper 11' consists of reddish-gray, nodular argillaceous limestone, and calcareous shale with some green mottling (fig. xiii). The following fossils were collected here: *Parmorthis brownsportensis*, *Schizoramma fissiplica*, *Isorthis arcuaria*, *Strophonella laxiplicata?*, *Trigonirhynchia*

tennesseensis, *Plasmopora follis*, *Heliolites nucella*, *Favosites brownsportensis*, and *Enterolasma waynense*.

- 4' Hard, gray, medium-crystalline, non-argillaceous limestone with beds to 2' thick. *Trigonirhynchia tennesseensis* and *Camarotoechia cedarensis* present.
- 61' Greenish-gray, argillaceous limestone and calcareous shale with nodular beds reaching 3" in thickness. There are a few beds of greenish-gray clay present but the amount of clay is subordinate to the argillaceous limestone. Specimens of *Eucalyptocrinites ventricosus* and *Leptaena tennesseensis* collected in the lower 15 feet.
- 6" Soft, pale-green clay.
- Dixon red limestone and clays.

Pate and Bassler (1908, p. 415) studied the section at Mousetail Bluff and found 104 feet of Brownsport strata which they referred to their "Lobelville" and "Beech River" divisions, believing the "Bob" to be absent. The writer finds 116 feet of Brownsport beds and regards this as representing the entire formation, the thickness and lithology being very similar to that seen elsewhere in the area studied.

The Brownsport formation is well exposed at old Rise Mill, about one mile south of Linden (section 37, figs. 6, xiv). The base of the formation consists of a foot or so of green clay resting upon the Dixon beds which are greenish-gray in the upper 8 or 10 feet, below this becoming mottled with red. Above this is 42 feet of limestone and calcareous shale with nodular beds ranging up to 3 or 4 inches in thickness. Some of the limestone beds have argillaceous material dispersed through them while in others the clay is concentrated in thin seams. The lower part of this unit has a greenish-gray color which grades upwards into a yellowish-gray. Overlying this is 4 feet of buff, medium- to coarsely-crystalline, non-argillaceous limestone. This is followed by 31 feet of buff, argillaceous limestone. Some of these limestone beds are non-argillaceous and are separated from one another by clay partings. Most of the beds are only a few inches in thickness but a few range up to 2 feet.

The Decatur has been removed in this area by post-Silurian erosion and the Brownsport is directly overlain by the Hardin sandstone which forms the basal member of the Chattanooga shale. Because of this unconformity the Brownsport formation is thin in this region.

Foerste studied the section at Rise Mill where he found 85 feet of Brownsport strata overlying "11 feet of reddish rock only doubtfully referred to the Dixon beds" (1903, p. 572). The writer thinks that there is 8 feet or so of greenish-gray, earthy limestones and clays lying above this reddish rock which clearly belongs to the Dixon, and therefore the measured thickness of 78 feet for the Brownsport is slightly less than that of Foerste. The latter also stated that the Brownsport in this area consists chiefly of limestone and shows comparatively little tendency to weather into glades. The writer agrees with Foerste that the formation is more calcareous in this area; however, a short distance south of here, at section 36, the lower 42 feet of the

Brownsport forms a good glade from which the following fossils were collected:

Hardin sandstone.

Brownsport formation.

18'—Largely covered; one or two outcrops of thin-bedded, nodular, argillaceous limestone.

9'—Thick-bedded, coarsely-crystalline, buff limestone. Carries *Wilsonella safordi* and *Atrypa tennesseensis*.

20'—Largely covered.

42'—Glade; some outcrops of thin-bedded, argillaceous limestone. Brachiopods are not numerous and only *Parmorthis brownsportensis*, *Schizoramma fissiplica* and *Atrypa tennesseensis* were found. *Pisocrinus* is common with the following species represented: *P. tennesseensis*, *P. sphericus*, *P. quinquelobus*, *P. campana*. Plates of *Caryocrinites* were found along with a few specimens of *Troosticrinus*. The corals are fairly numerous with the following species present: *Heliolites spongiosus*, *Favosites louisvillensis*, *Emmonsia planobasalis*, *Romingerella major*, *Thecia minor*, *Ditoecholasma fanninganum*, *Cyathophyllum cliftonense*, *Rhizophyllum tennesseense* and *Naos brownsportensis*.

Dixon red clays and limestones.

Pate and Bassler (1908, p. 424) describe a section at Rise Mill in which they find the "Lobelville formation" to be overlain by 16 feet of Decatur limestone. The writer is unable to reconcile his description with theirs for no Decatur limestone was found to be present in this area and the only coral zone was found in the lower 40 feet of the Brownsport.

At Sewell's spring in the northern part of the Clifton quadrangle the Brownsport formation yields a great variety and number of corals as well as numerous specimens of *Rhipidium pingue* and *R. sewellense*. Only the upper part of the formation is exposed here where it forms a glade on which the corals weather out free. Below is the section measured at 11.

Hardin sandstone.

Decatur limestone.

18' Coarsely-crystalline, gray, crinoidal limestone.

Brownsport formation.

14' Covered.

3' Gray limestone; *Rhipidium pingue* and *R. sewellense* are very numerous and form a coquina.

42' Glade with scattered outcrops of thin-bedded, yellowish-gray, argillaceous limestone and calcareous shale. At the base is a small ledge of earthy, rusty, brown limestone. The following species present: *Parmorthis brownsportensis*, *Mendacella cliftonensis*, *Myelodactylus extensus*, *Caryocrinites milliganae*, *Plasmopora foliis*, *Cosmolithus sewellensis*, *Heliolites spongiosus*, *H. distans*, *Favosites louisvillensis*, *F. brownsportensis*, *Emmonsia planobasalis*, *Halysites catenularia brownsportensis*, *Cladopora*? *brownsportensis*, *C*? *reticulata*,

Platyaxum planostiolatum, *Striatopora gwensis*, *Planalveolites louisvillensis*?, *Romingerella major*, *Thecia minor*, *Ditoecholasma fanninganum*, *D. acutianulatum*, *Arachnophyllum pentagonum*, *Entelophyllum rugosum*, *Cyathophyllum cliftonense*, *Cystiphyllum lineatum*, *Naos sewellensis*.

Covered slope, base of Brownsport not exposed.

The type locality for the "Bob" division of the Brownsport formation is located about a half mile north of Bob's Landing on the west bank of the Tennessee River in Bath Springs quadrangle (location 33 of this report). At location 33 the lower part of the formation lies below the river level but there is a fairly good exposure of the middle and upper parts. The dip of the strata is such that a short distance north of here at location 5 and 6 the Dixon lies above the river. At 5 the overlying Decatur is also exposed and the Brownsport was found to have a thickness of about 105 feet; however, this is not a very satisfactory section as the beds are poorly exposed. The best exposures which we were able to find in this area are at location 33 and this section is given below.

Hardin sandstone.

Decatur limestone.

6' Buff, medium-grained limestone with a small amount of chert. Beds to 3 feet.

Brownsport

25' Covered.

12' Buff to gray, medium-grained limestone in beds to 3 inches. Numerous clay seams (fig. xv).

25' Glade with a few outcrops of yellowish gray limestone and calcareous shale. The following collected here: *Mendacella cliftonensis*, *Sieberella roemeri*, *Strophonella roemeri*, *Fardenia roemeri*, *Leptaena tennesseensis*, *Camarotoechia perryvillensis*, *C. shannonensis*, *C. eccentrica*, *C. acutiplicata*, *C. cedarensis*, *Trigonirhynchia tennesseensis*, *Wilsonella saffordi*, *Wilsonella? compressa*, *Atrypa tennesseensis*, *Lissatrypa decaturensis*, *Coelospira saffordi*, *Delthyris saffordi*, *Merista tennesseensis*, *Homoeospira elongata*, *H. schucherti*, *Pleurodictyum tennesseense*, *Enterolasma waynense*, *Anisophyllum agassizi*.

5' Buff, fine-grained limestone in beds to 3 or 4 inches. Many clay seams. Following species present: *Camarotoechia acutiplicata*, *C. cedarensis*, *Trigonirhynchia tennesseensis*, *Wilsonella saffordi*, *Atrypa tennesseensis*, *Merista tennesseensis*.

11' Partly covered. One or two exposures of thin-bedded, argillaceous limestone and calcareous shale.

Pate and Bassler (1908, p. 421) described a section a half mile north of Bob's Landing which they referred to their "Bob" formation. This division was set up primarily to include about 60 feet of brachiopod-bearing strata, for their lithologic description does not differ to any extent from that which they gave at the type section of the "Beech River" and at other localities which they examined. Since they gave neither a top nor a bottom to this section its exact position within the Brownsport formation is not definitely

known. The writer has not been able to correlate his lithologic divisions at section 33 with those given by Pate and Bassler, but a tentative correlation based upon those strata in which the brachiopod facies is well developed indicates that their units (c), (d), (e) and (f) are equivalent to the 25-foot glade shown above. If such a correlation is correct, then the top of the "Bob" as described by them lies about 27 feet below the top of the Brownsport and the base about 15 or 20 feet above the Dixon contact. The writer does not find any lithologic basis for subdividing the formation in this area nor does there appear to be any significant difference in the thickness or lithology here and that seen at other places throughout the area. The brachiopod facies is well developed in this central part of the formation but most of the species listed above appear to range throughout the Brownsport.

The "Lobelville" formation was named for exposures in the vicinity of Lobelville. The best section is at location 38, about a mile north of the town. Section 38 (fig. 6) was compiled from exposures on the south bank of the Buffalo River extending east from Gilmore bridge for a quarter of a mile. Only the upper 55 feet of the Brownsport is exposed and consists of buff to greenish-gray, argillaceous limestones and calcareous shales with nodular beds ranging up to 4 inches in thickness. The strata lying 17 to 30 feet below the Decatur contact have weathered into a glade which yields a large coral fauna, the following species being represented in the collections: *Heliolites tennesseensis*, *H. nucella*, *Favosites louisvillensis*, *F. beechensis*, *F. brownsportensis*, *Halysites catenularia brownsportensis*, *Cladopora?* *reticulata*, *Planalveolites louisvillensis?* *P. lobelvillensis*, *Romingerella major*, *Entelophyllum rugosum*, *Amplexus brownsportensis*, *A. shumardi*, *Cyathophyllum cliftonense*, *C. angulare*, *Cystiphyllum lineatum*. The following brachiopods are also present: *Rhipidium pingue*, *Sieberella roemeri* and *Atrypa tennesseensis*.

The exposures of the Brownsport formation in and around Clifton have been studied by a number of geologists including Safford, Foerste and Pate and Bassler. At the present time the strata are not very well exposed within the town limits but a fairly complete section may be seen in the bluffs of the Tennessee River three-fourths of a mile west of Clifton. Section 8, located here, is given below:

Brownsport formation. Covered to top of bluff.

- 30' Green, calcareous shale with thin, nodular limestone beds to 4 inches (fig. xvi).
- 2' Gray, non-argillaceous limestone.
- 1' Blue-green calcareous shale.
- 3' Gray, non-argillaceous limestone.
- 8' Thin-bedded (to 3") argillaceous limestone and greenish-brown shale.
- 16' Green, calcareous shale with a few thin limestone beds.
- 12' Thin-bedded (to 3") limestone interbedded with green calcareous shale. A few of these limestone beds are crinoidal and carry thin clay seams.

13' Greenish-gray, calcareous shale with argillaceous limestone. Bedding nodular, ranging up to 4 to 5 inches in thickness. Some of the limestones are crinoidal.

7' Gray-green, thin-bedded (to 6") argillaceous limestone mottled with red. A few calcareous shale beds.

3' Soft, green clay.

Dixon red limestones and clays.

The lithology of the Brownsport strata in the above section is similar to that seen at other localities except there is slightly more shale than usual. The total thickness is 95 feet and represents almost all of the formation, with only the upper 10 or 20 feet covered. This agrees very well with Foerste who found the Brownsport beds at this locality to be 100 feet thick. Pate and Bassler measured an incomplete section of the Brownsport at Clifton, 90 feet thick.

The present study of the Brownsport does not support Pate and Bassler's contention that this formation consists of three distinct lithologic units. The Brownsport strata exposed at the type locality of the "Beech River formation" south of Perryville do not differ to any extent from those seen at Bob's Landing or at Lobelville. At these localities as well as at Brownsport Furnace, Mousetail Bluff, Rise Mill, Sewell's Spring and Clifton, the formation consists of a rather uniform sequence of thin-bedded, argillaceous limestones and calcareous shales with a few lenses of thicker-bedded, non-argillaceous limestone. Nor can the writer agree with Pate and Bassler's idea that the Brownsport has a total thickness of 257 feet. In those places where the complete thickness is exposed with the Dixon below and the Decatur above, it ranges from 95 feet (section 39) to 116 feet (section 13). As shown in figure 6, the complete thickness is 108 feet at locality 48, 114 feet at locality 27, 105 feet at locality 17 (not shown on fig. 6), 110 feet at locality 15 and 95 feet at locality 3. Considering that these sections extend over a large area this variation in thickness is not thought to be significant and is believed to represent an essentially conformable sequence.

As earlier stated, Pate and Bassler believed that each of their divisions was characterized by a distinct lithology and fauna but a careful study of their description shows that the primary consideration in the recognition of these units was the fauna and not the lithology. The matter of faunal distribution will be discussed more fully in the next chapter.

LITHOLOGIC VARIATION WITHIN THE FORMATION. Later workers have continued to use the terms "Beech River," "Bob" and "Lobelville" but have tried to base these divisions upon lithologic differences (fig. 4). As noted before it has been the practice of these investigators to refer those thick-bedded, non-argillaceous limestone units within the Brownsport formation to the "Bob" while the "Beech River" and "Lobelville" have been regarded as thin-bedded, argillaceous limestones and calcareous shales with varying amounts of chert. The writer finds it true that within a zone 50 to 80 feet above the base of the formation there are local lenses of solid limestone, but they are

not continuous and do not fall within the same precise stratigraphic limits.

One of the best places to see the lensing character of these beds is in the bluffs of the Tennessee River at Mousetail (section 13) and Lady Finger (sections 14, 41) in Jeannette quadrangle. At section 14 a 17-foot unit of thick-bedded, non-argillaceous limestone lies between 37 and 54 feet below the top of the Brownsport formation (figs. xvii, xviii). It is medium- to coarsely-crystalline with beds ranging up to 4 feet in thickness and is lithologically quite distinct from the thin-bedded, argillaceous limestone and

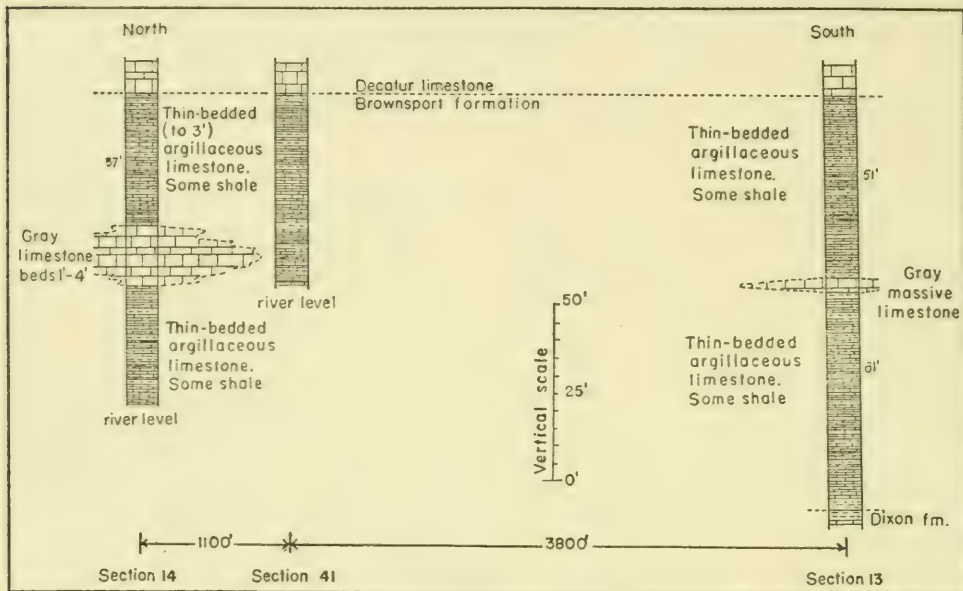


Figure 19. Sections at Mousetail (location 14) and Lady Finger bluffs (location 13) showing facies variation of the massive limestone ("Bob") in the Brownsport formation. For location, see map, fig. 1.

calcareous shale above and below. Towards the south this limestone tongues out into argillaceous limestones and shales so that at section 41 it is completely absent, while farther south at section 13 there is a limestone of similar lithology but here it is only 4 feet thick. This facies change is shown in figure 19.

There is no limestone of this type in sections 39, 4 and 40 of Perryville quadrangle but it reappears to the east in section 31 (Pope quadrangle) as is shown in the following section:

Decatur and Devonian limestone.

78' Gray, medium- to coarse-grained, crinoidal limestone. *Delthyris saffordi*, *Trigonirhynchia tennesseensis*, *Leptaena tennesseensis* and *Wilsonella saffordi* were collected 12 to 17 feet above the base. The upper 4 or 5 feet carries Lower Devonian fossils.

Brownsport formation.

40' Thin-bedded (to 3") buff, argillaceous limestones and calcareous shales. Two hundred feet east of here this part of the Brownsport forms a glade from which the following were collected: *Sieberella roemeri*, *Atrypa tennesseensis*, *Favosites louisvillensis*, *F. brownsportensis*, *Romingerella major*, *Thecia minor*.

26' Gray, medium- to coarse-grained, non-argillaceous limestone in beds to 2 feet. This is the "Bob" limestone.

Covered: Base of Brownsport not exposed.

At old Rise Mill (section 37) a 4-foot bed of non-argillaceous limestone lies 43 feet above the base of the Brownsport formation (fig. xiv). A short distance to the south, at section 36, there is a 9-foot unit of thick-bedded, non-argillaceous limestone, but it lies 62 feet above the base of the formation.

The lensing character of such limestones is well shown in the bluffs of the Tennessee River at location 27 (Clifton quadrangle). At this section a 23-foot unit of thick-bedded, non-argillaceous limestone lies 30 feet below the top of the formation (fig. 6), but when traced along the strike it may be seen to thin rapidly so that 200 feet to the south it is only 8 feet thick, and a short distance beyond it disappears completely.

At section 17, a short distance south of section 27, there is only a 4-foot bed of such limestone within the formation as shown in the section below:

Hardin (?) sandstone.

Decatur limestone.

17' Medium- to coarse-grained, gray crinoidal limestone in beds to 2 or 3 feet.

Brownsport formation.

10' Thin-bedded (to 5") nodular, argillaceous limestone.

13' Covered.

4' Gray, medium-grained, non-argillaceous limestone in beds to 2 feet ("Bob").

71' Partly covered; some outcrops of thin, nodular-bedded buff, argillaceous limestone with a little calcareous shale. In part mottled with red. The following species were collected in the upper 20 feet: *Parmorthis brownsportensis*, *Isorthis arcuaria*, *Enterolasma waynense* and *Amplexus brownsportensis*. Specimens of *Caryocrinites milliganae* and *Troosticrinus reinwardti* were collected in the lower 30 feet.

Dixon red clays and red, earthy limestones.

Another thick limestone unit of this character may be seen in the Brownsport formation at location 3 on the east bank of the Tennessee River in Clifton quadrangle (fig. 6). There it consists of 25 feet of thick-bedded, gray, coarsely-crystalline limestone which lies 10 feet below the Brownsport-Decatur contact. Just to the south, at sections 2 and 1, only the lower 40 feet or so of the Brownsport formation is exposed and it consists of thin-bedded, argillaceous limestones and shales with no trace of any thicker-bedded limestone units.

None of the Brownsport exposures in the vicinity of Bob's Landing (Bath Springs quadrangle) show any thick-bedded limestone. West of there, at location 23, the writer has measured an incomplete section consisting of thin, nodular-bedded, argillaceous limestones and calcareous shales which are in part glade forming. The section measured at location 24 is very similar to that at 23 and shows no trace of any of the "Bob" limestone units. Section 24 is given below:

Brownsport formation.

33' Mostly covered; a few outcrops of thin-bedded, argillaceous limestone in the lower part.

4' Nodular-bedded, argillaceous limestone and shale.

7' Thin-bedded (to 4") nodular, argillaceous, buff limestone.

22' Glade; some outcrops of argillaceous limestone and clay. The following brachiopods collected here: *Parmorthis brownsportensis*, *Mendacella cliftonensis*, *Sieberella roemeri*, *Strophonella laxiplicata*? *Camarotoechia perryvillensis*, *C. acutiplicata*, *Wilsonella saffordi*, *Atrypa tennesseensis*, *Lissatrypa decaturensis*, *Coelospira saffordi*, *Delthyris saffordi*, *Merista tennesseensis* and *Homocospira elongata*. Only one coral was found here, *Anisophyllum agassizi*.

3' Fine-grained, even-bedded, earthy limestone.

17' Partly covered; few outcrops of thin-bedded, argillaceous limestone and calcareous shale.

Dixon red limestones and clays.

At section 8 near Clifton only two thin beds of non-argillaceous limestone are present. Between Clifton and locality 53 (Eagle Creek quadrangle) only the lower 30 feet of the Brownsport formation is exposed; therefore it is not possible to determine whether or not any such limestone lenses were present. At location 53 the Brownsport carries a 22-foot bed of "Bob" limestone as shown in the section below:

Hardin sandstone.

Brownsport formation.

15' Covered.

22' Coarse-grained, gray, crinoidal limestone in beds to 2 or 3 feet.

33' Interbedded argillaceous limestone and calcareous shale. *Rhizophyllum* and *Troosticrinus* found here.

Covered: base of Brownsport not exposed.

At location 20 in Eagle Creek quadrangle only the lower 30 feet of the Brownsport may be seen, but about a mile southwest, at location 19, 78 feet of the formation is exposed. This includes one 12-foot unit of coarse-grained, gray limestone but unfortunately its exact stratigraphic position cannot be determined since neither the top nor the bottom of the Brownsport is exposed. The section at 19 is given below:

Brownsport formation.

Covered: top of formation not exposed.

- 25' Partly covered; few outcrops of thin-bedded, argillaceous limestone and calcareous shale. *Heliolites spongiosus* collected here.
- 12' Coarse-grained, gray limestone ("Bob"). The following collected in the upper part of this limestone: *Sieberella roemeri*, *Dictyonella gibbosa*, *Wilsonella saffordi*, *Atrypa tennesseensis*, *Merista tennesseensis*, *Pisocrinus quinquelobus*, *Lecanocrinus pisiformis*.
- 5' Covered.
- 1' Lemon-yellow, earthy limestone.
- 5' Calcareous shale with a little thin-bedded limestone. The following species present here: *Parmorthis brownsportensis*, *Isorthis arcuaria*, *Atrypa tennesseensis*, *Pisocrinus quinquelobus*, *Caryocrinites milliganae*, *Troosticrinus reinwardti*, *Favosites discoideus*, *Anisophyllum agassizi*.
- 6' Glade: outcrops of calcareous shale and thin-bedded, argillaceous limestone. The following species represented here: *Parmorthis brownsportensis*, *Schizoramma fissiplica*, *Mendacella cliftonensis*, *Isorthis arcuaria*, *Bilobites* cf. *B. bilobus*, *Leptaena tennesseensis*, *Eucalyptocrinites ventricosus*, *Caryocrinites milliganae*, *Troosticrinus reinwardti*, *Heliolites spongiosus*, *Thecia minor*, *Ditoecholasma fanninganum*, *Enterolasma waynense*, *Entelophyllum rugosum*, *Amplexus brownsportensis*, *Rhizophyllum tennesseensis*, *Wilsonella saffordi*, *Atrypa tennesseensis*.
- 13' Interbedded yellow calcareous shale and thin-bedded, argillaceous limestone. Covered; base of Brownsport not exposed.

The Brownsport formation is covered between location 19 and the northern part of the Martins Mills quadrangle.

Foerste proposed the name Gant limestone for strata exposed in the vicinity of the old Gant homestead in the northern part of the Martins Mills quadrangle (fig. 4). At the present time the outcrops at this place are very poor, but a short distance south, along Indian Creek (localities 45, 42) there are better exposures. Section 45 is given below:

Chattanooga shale,

Fissile, black to gray shale.

Hardin sandstone.

13' Brown, fine-grained sandstone.

Brownsport formation.

6' Partly covered; a few outcrops of thin-bedded, argillaceous limestone

19' Buff to gray, medium-grained limestone in beds to 2 feet. This is the "Gant" limestone of Foerste and the "Bob" limestone of later workers.

40' Partly covered; some outcrops of thin-bedded, argillaceous limestone and calcareous shale.

7' Greenish-gray, thin-bedded (to 2") nodular, argillaceous limestone.

14' Covered.

1' Green clay.

Dixon red limestones and clays.

The 19-foot limestone shown above is undoubtedly the bed which Foerste called the Gant and which, together with the overlying 6-foot unit of thinner-bedded limestone, formed his Gant beds. This Gant limestone of Foerste was included in the "Bob limestone" of Dunbar, Miser and other workers.

A similar lithologic sequence may be seen at section 42 (fig. 6) although here the massive limestone bed is only 9 feet thick. The relationship of the limestone units of these two sections is shown in figure 20.

A short distance west of Houston (Martins Mills quadrangle) a road cut gives an excellent exposure of the upper Brownsport beds (section 52). At

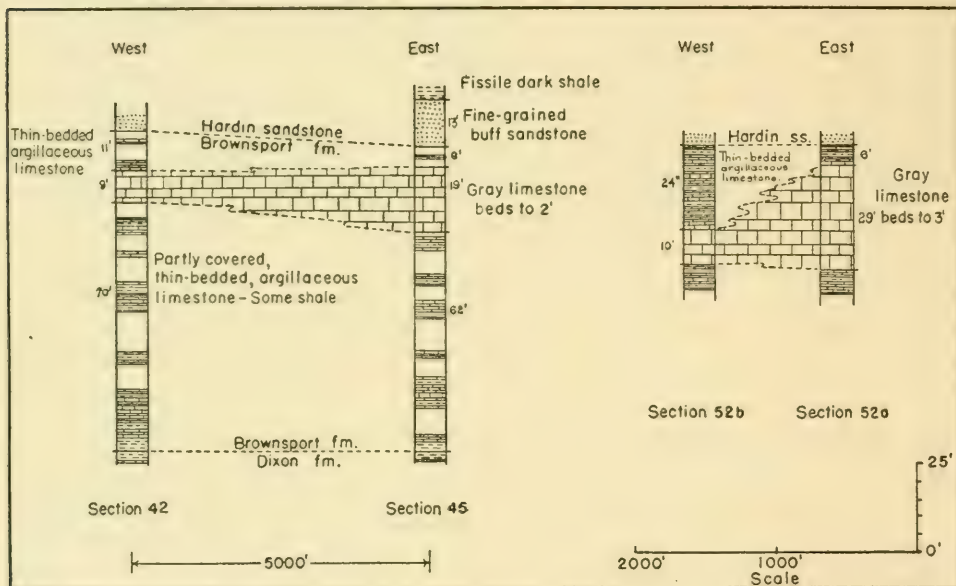


Figure 20. Sections near the old Gant homestead showing facies variation of the massive limestone (Gant) in the Brownsport formation. For location, see map, fig. 1.

this locality a thick-bedded, non-argillaceous limestone unit (Gant) may be clearly seen to tongue out into thin-bedded, argillaceous limestones and shales. Figure 20 shows this facies change.

The Brownsport sections discussed in the preceding pages show that the beds in a zone 50 to 80 feet above the base of the formation may lose their thin-bedded, argillaceous character and form thick-bedded, medium- to coarse-grained limestones. Such limestone lenses do not hold a constant position in the formation; they vary greatly in thickness, grading laterally into the typical argillaceous facies of the Brownsport formation within short distances, and are absent in many of the exposures. The inferred distribution of these "Bob" or "Gant" limestone lenses is shown in figure 21. The distance between measured outcrops in the sections shown in this figure is con-

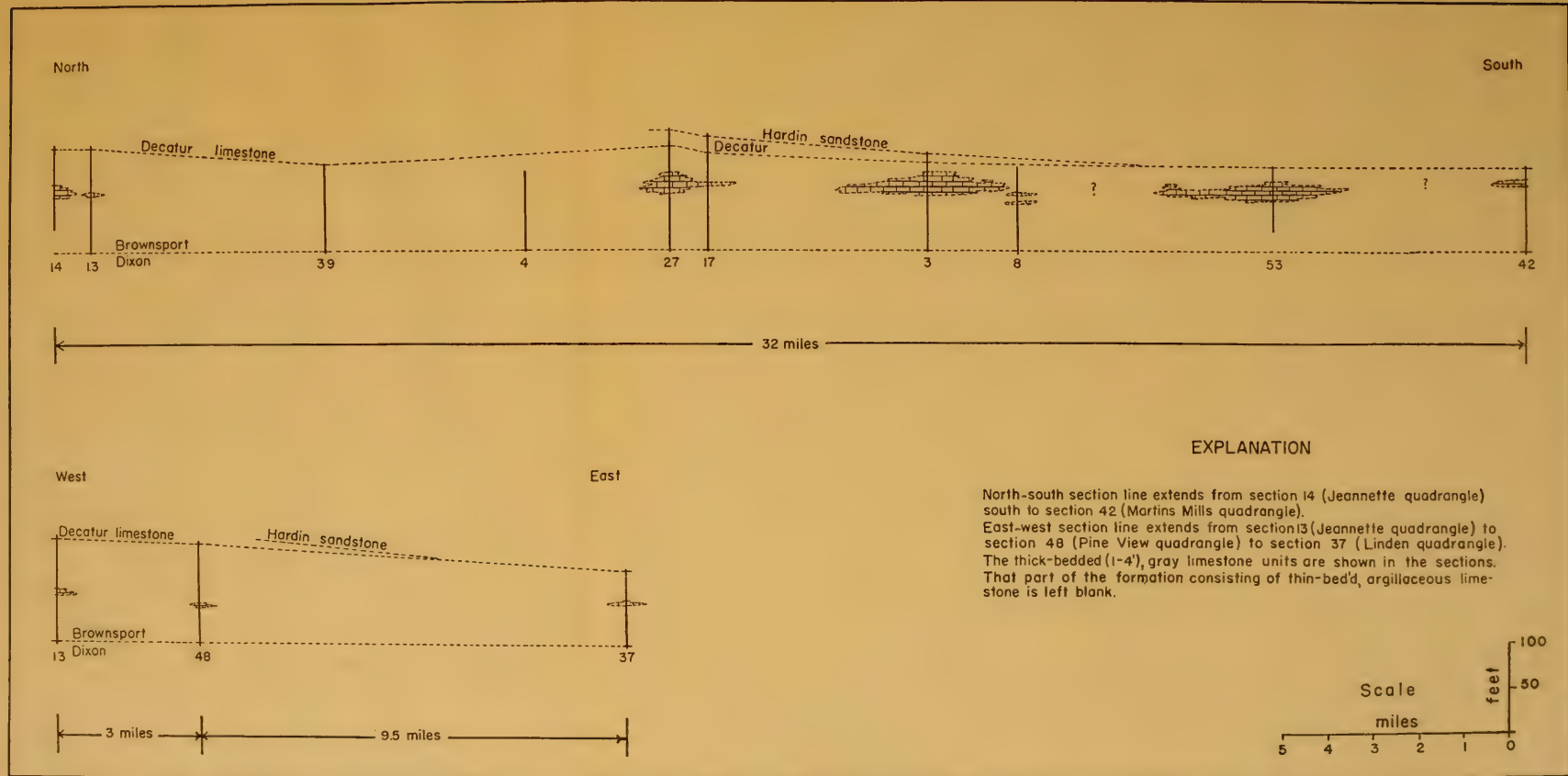


Figure 21. Sections showing inferred distribution of the massive limestone units in the Brownsport formation. For location, see map, fig. 1.

siderable and therefore it is not suggested that the figure represents an exact picture of the stratigraphy along these lines of section, but it does present a fair although somewhat generalized illustration of the nature of the facies variation within the formation.

Limestone lenses of this character do not seem to offer a firm foundation upon which to establish a member or a formation. Since these units are so irregular in their distribution, and since the beds above and below are so similar in lithology, there does not appear to be any valid basis for subdividing the Brownsport into three members or formations and therefore it is proposed that the terms "Beech River," "Bob" and "Lobelville" be abandoned. If the term "Gant" is retained at all it should be used for the "Gant limestone lentil," and restricted to the northern part of the Martin's Mills quadrangle.

SUMMARY. The present study shows that the Brownsport formation consists of a distinct lithologic unit which overlies the Dixon formation with apparent conformity and underlies the Decatur in the same relation. Measured sections of the complete formation range from a minimum thickness of 95 feet (section 39) to a maximum thickness of 116 feet (section 13) and show that it consists of an essentially conformable sequence of thin-bedded, argillaceous limestones and shales with minor amounts of chert. The color is generally yellow to greenish-gray which in some localities is mottled with red. The strata in a zone 50 to 80 feet above the base of the formation locally include thick-bedded, rather pure limestone lenses, but these vary greatly in thickness and are absent in many parts of this area. This lithologic sequence does not furnish any satisfactory basis upon which to subdivide the Brownsport into formations or members and it is therefore proposed that the terms "Beech River," "Bob" and "Lobelville" be abandoned.

STRATIGRAPHIC AND GEOGRAPHIC DISTRIBUTION OF THE FAUNA

Pate and Bassler's division of the Brownsport into three "formations" was based upon the fauna. Below is a list of the faunal zones which they recognized:

Lobelville	Coral zone Bryozoa zone
Bob	Conchidium [Rhipidium] zone Dictyonella zone. Uncinulus [Trigonirhynchia and Camarotoechia] zone.
Beech River	Eucalyptocrinus zone Troosticrinus zone Coccocrinus [Lyonicrinus] zone

They also gave a list of the species which they believed to be characteristic of each "formation." No descriptions or illustrations were included and so it is not possible to be certain of their identification, but the right hand column below indicates the inferred present identification of the species which they listed.

As listed by Pate and Bassler

As now identified

LOBELVILLE CORALS

Alveolites louisvillensis	Planalveolites louisvillensis
Alveolites niagarensis	? Planalveolites louisvillensis
Amplexus shumardi	Amplexus shumardi
Cladopora complanata	? Cladopora reticulata
Cladopora reticulata	Cladopora reticulata
Coenites verticillata	Coenites verticillatus
Favosites cristatus	Favosites clavatus n.sp.
Favosites cristatus major	not recognized
Favosites discus	? Favosites louisvillensis
Favosites favosus	Favosites brownsportensis n.sp.
Favosites louisvillensis	Favosites louisvillensis
Favosites niagarensis	? Favosites louisvillensis
Favosites spongilla	Favosites beechensis n.sp.
Heliolites interstinctus	Heliolites spongiosus
Plasmopora follis	Plasmopora follis
Calceola tennesseensis	Rhizophyllum tennesseense
Thecia major	Romingerella major
Thecia minor	Thecia minor

BOB BRACHIOPODS

<i>Spirifer saffordi</i>	<i>Delthyris saffordi</i>
<i>Dictyonella gibbosa</i>	<i>Dictyonella gibbosa</i>
<i>Nucleospira concentrica</i>	<i>Lissatrypa decaturensis</i> n.sp.
<i>Wilsonia saffordi</i>	<i>Wilsonella saffordi</i>
<i>Uncinulus stricklandi</i>	<i>Trigonirhynchia tennesseensis</i> and <i>Camarotoechia cedarensis</i> n.sp.
<i>Schuchertella</i> (<i>Orthothetes</i>) <i>subplanus</i>	<i>Fardenia roemeri</i>
<i>Meristina maria-roemeri</i>	not described
<i>Gypidula roemeri</i>	<i>Sieberella roemeri</i>
<i>Camarotoechia neglecta</i>	<i>Camarotoechia shannonensis</i> n.sp. and <i>eccentrica</i> n.sp.
<i>Conchidium</i>	<i>Rhipidium</i>

BEECH RIVER CRINOIDS AND BLASTOIDS

<i>Eucalyptocrinus milliganae</i>	<i>Eucalyptocrinites milliganae</i>
<i>Eucalyptocrinus ventricosus</i>	<i>Eucalyptocrinites ventricosus</i>
<i>Lampteroocrinus tennesseensis</i>	<i>Lampteroocrinus tennesseensis</i>
<i>Callicrinus ramifer</i>	<i>Callicrinus ramifer</i>
<i>Marsupioocrinus tennesseensis</i>	<i>Marsupioocrinus tennesseensis</i>
<i>Marsupioocrinus striatus</i>	<i>Marsupioocrinus striata</i>
<i>Lecanocrinus pisiformis</i>	<i>Lecanocrinus pisiformis</i>
<i>Herpetocrinus gorbyi</i>	<i>Myelodactylus gorbyi</i> —this is a Waldron species which has not been identified from the present collection nor does Springer (1920) describe it.
<i>Calceocrinus</i> sp.	<i>Calceocrinus</i>
<i>Pisocrinus milliganae</i>	<i>Pisocrinus quinquelobus</i>
<i>Pisocrinus gemmiformis</i>	? <i>Pisocrinus campana</i>
<i>Thalamocrinus ovatus</i>	<i>Thalamocrinus ovatus</i>
<i>Thalamocrinus cylindricus</i>	<i>Thalamocrinus cylindricus</i>
<i>Thysanocrinus milliganae</i>	<i>Dimerocrinus milliganae</i>
<i>Sagenocrinus</i> sp.	<i>Sagenocrinus</i>
<i>Troosticrinus reinwardti</i>	<i>Troosticrinus reinwardti</i>
<i>Caryocrinus bulbulus</i>	<i>Caryocrinus milliganae</i>

Pate and Bassler, it is evident, thought that each of their "formations" carried a particular fauna and that where this fauna was absent, strata were missing. This is illustrated by an examination of the sections which they gave for Lady Finger and Mousetail Bluffs (sections 14, 13 of this report). They found the "Beech River" crinoid and blastoid beds, the "Bob" brachiopod beds and the "Lobelville" coral beds present at Lady Finger Bluff, but at Mousetail Bluff, a short distance to the south, the brachiopod fauna was not found and so they show the "Lobelville formation" resting directly upon the "Beech River formation." Another example may be seen in their interpretation of the strata exposed at the type locality of the "Beech River" (section 39 of the present report). There they did not find the brachiopod or

coral fauna and interpreted this as indicating that strata representing the "Bob and Lobelville formations" were absent.

Where these "formations" were lacking, they believed that their absence was due to unconformities within the Brownsport, and they state (1908, p. 409) that "so far as observed, no single locality affords a complete and continuous section of all the Niagaran strata known to occur in the area. For example, at the type-locality [*sic*] Clifton, in Wayne County, a considerable portion of the later Niagaran is wanting . . . It is, therefore, only by comparing section after section that the complete succession may be determined." To get this, they built up a composite section by adding together the maximum measured thickness of beds in which the crinoid fauna is well developed and the maximum measured thickness of beds carrying a well developed brachiopod fauna and coral fauna. Such a composite section is based upon the assumption that each of these faunal units was restricted to a certain group of strata and that there was no overlap of one unit upon another.

Pate and Bassler's faunal "zones" were based upon scattered exposures where the characteristic fauna was locally abundant and do not prove to be valid zones for the following reasons: (1) nearly all the species range more widely than indicated, their local abundance being due to favorable local ecology on the sea floor; (2) they cannot be recognized except locally; (3) even where recognized they do not hold a constant order of succession, as is well shown at the Sewell Spring locality where the *Rhipidium* zone of the "Bob formation" lies above the rich coral horizon of the "Lobelville formation."

The present study shows that the stratigraphic distribution of the fauna is a matter of facies and not of age relationship and indicates that while the species of any particular group are in general most numerous in a certain strata they are, for the most part, not confined thereto nor are they equally well developed in these particular strata at all localities. A more detailed examination of the different fossil groups studied in this report will illustrate this point.

The environment most suited for brachiopod life was best developed in middle Brownsport times. This is shown by the fact that the brachiopods are in general most numerous in a zone 30 to 60 feet above the base of the formation, but this facies is not developed everywhere throughout the area within this zone. Such facies variation is clearly demonstrated when it is noted that the brachiopods are abundantly represented in the middle portion of the formation at localities 4, 9, 18, 33, 49, but are not common at other localities such as 13, 15, 27 and 39 where the formation is equally well exposed. The chart, figure 22, gives a complete list of the species studied in this report with their geographic distribution.

Although the brachiopods are most numerous in the middle part of the formation they are not restricted to this zone. Almost all the species which are common enough to be statistically representative are not confined to this part of the Brownsport. The following is a list of those brachiopod species

which are represented by numerous individuals and which have been collected throughout most of the formation: *Parmorthis brownsportensis*, *Mendacella cliftonensis*, *Isorthis arcuaria*, *Schizorammina fissiplica*, *Sieberella roemeri*, *Camarotoechia perryvillensis*, *C. acutiplicata*, *Trigonirhynchia tennesseensis*, *Wilsonella saffordi*, *Leptaena tennesseensis*, *L. delicata*, *Atrypa tennesseensis*, *Lissatrypa decaturensis*, *Merista tennesseensis* and *Homocospira elongata*. In addition to these many of the less common species have been collected throughout the formation.

Pate and Bassler divided the "Bob formation" into 3 faunal zones, the highest being characterized by the genus *Conchidium*. This is the genus which is here called *Rhipidium*, and which has been found at only 6 localities, in the upper 30 feet of the formation. At section 11 near Sewell's Spring a great many specimens of *Rhipidium pingue* and *Rhipidium sewellense* have been found in a limestone ledge lying 12 feet below the top of the Brownsport, and just above a prolific coral horizon (p. 16). The genus has also been collected in the upper 30 feet of the formation at localities 26, 43, 46 and 38; at this last locality it is associated with a large variety of corals (p. 18). The only other place where *Rhipidium* has been found is at location 28 in Pope quadrangle where it is associated with the following: *Mendacella cliftonensis*, *Isorthis arcuaria*, *Sieberella roemeri*, *Camarotoechia perryvillensis*, *Trigonirhynchia tennesseensis*, *Atrypa tennesseensis*, *Lissatrypa decaturensis*, *Delthyris saffordi*, *Homocospira schucherti*, *Pisocrinus quinquelobus*, *Heliolites distans*, *H. nucella*, *Favosites louisvillensis?* *F. discoideus*, *F. brownsportensis*, *Cladopora?* *brownsportensis*, *C?* *reticulata*, *Planalveolites louisvillensis?*, *Romingerella major*, *Thecia minor*, *Ditoecholasma acutiannulatum*, *Enterolasma waynense*, *Amplexus brownsportensis*, *A. shumardi*, and *Cyathophyllum cliftonense*. Unfortunately at locality 28 neither the top nor the bottom of the Brownsport formation is exposed and therefore the exact stratigraphic position is not known although it is thought to be in the upper third of the formation.

Dictyonella characterized the middle zone of Pate and Bassler's "Bob formation" but it is so rare that no general observation can be made regarding its distribution. The present collections contain only 5 specimens of *Dictyonella gibbosa* which were found in a zone 30 to 50 feet above the base of the Brownsport at locations 18 and 19.

Uncinulus stricklandi constituted the basal zone of the "Bob formation." The writer has divided this into two species, *Trigonirhynchia tennesseensis* and *Camarotoechia cedarensis*, n.sp., the former being common and found throughout the formation, the latter more restricted and found only in the middle portion of the Brownsport (30 to 70 feet above the base).

The present report includes a study of the coral species listed on figure 22. Two of these species, *Ditoecholasma fanninganum*, and *Enterolasma waynense*, show little relation to any particular facies, being common at many localities and found throughout the formation. The environment best suited for most of the species, however, was probably best developed during later Brownsport times, for the corals are in general most abundant in the

upper 40 or 50 feet of the formation. As in the case of the brachiopods this facies was not everywhere present at this time. In some localities such as 11, 28, 4 and 38 the upper 40 feet of strata carry many corals, the most common species being: *Heliolites tennesseensis*, *H. distans*, *H. nucella*, *Favosites brownsportensis*, *F. louisvillensis*?, *Romingerella major*, *Thecia minor*, *Amplexus shumardi*, *A. brownsportensis*, *Cyathophyllum cliftonense*, *C. pegramense* and *C. angulare*. At other localities such as 39 and 8 where this portion of the formation is well exposed the corals are poorly represented.

Although the corals as a group may possibly have their best development in the upper part of the Brownsport, many of the species are known to occur at lower horizons. A good example of this may be seen at locality 36 south of the Rise Mill where the following species were collected from the lower 40 feet of the formation: *Heliolites spongiosus*, *Favosites louisvillensis*, *Emonsia planobasalis*, *Romingerella major*, *Thecia minor*, *Ditoecholasma fanninganum*, *Cyathophyllum cliftonense*, *Rhizophyllum tennesseense*, and *Naos brownsportensis*.

The writer has found *Rhizophyllum tennesseense* only in the lower 40 feet of the formation where it is not usually associated with the principal coral fauna.

Although a large number of crinoid species have been described from the Brownsport formation individual specimens are rather uncommon. Many of the described species were collected for Springer who directed rather extensive operations for this purpose.

Enough specimens have been obtained during the present investigation to suggest that the principal crinoid fauna is not commonly associated with the brachiopod or coral faunas but has its best development in the lower part of the formation. *Pisocrinus quinquelobus* and *P. campana* are an exception to this, being common and widespread throughout the Brownsport.

Pate and Bassler divided the "Beech River formation" into three zones of which the lowest was characterized by *Coccocrinus* [*Lyonicrinus*], the next by *Troosticrinus* and the highest by *Eucalyptocrinites*. All three of these genera are represented in the present collection but none are common enough to serve as a very good basis of zonation. Furthermore, *Eucalyptocrinites* and *Troosticrinus* are not confined to any particular zone but range throughout the formation. Only two specimens of *Lyonicrinus bacca* have been found, both in the lower 40 feet.

A large number of plates and several complete specimens of the cystoid *Caryocrinites milliganae* have been found. It ranges through the formation but is usually associated with the crinoid fauna.

SUMMARY. The results of the present study indicate that the brachiopod, crinoid and coral faunas of the Brownsport beds form three fairly distinct facies and that in those strata where one of these groups is well developed the other two are usually only poorly represented. In general it may be stated that the crinoid facies is best developed in the lower part, the brachiopod facies in the middle part and the crinoid facies in the upper part of

the formation although there are exceptions to this order of succession. It does not appear to the writer that this faunal distribution will fit into the three-fold division of "Beech River," "Bob" and "Lobelville" formations as defined by Pate and Bassler. The objections may be summarized as follows:

1. These faunal facies are not everywhere present, being well developed in one area and poorly developed or absent in another. For example, the brachiopod fauna is well developed at old Brownsport Furnace (locality 4) but is absent at the type locality of the "Beech River" (locality 39).

2. This sequence of "Beech River" crinoids, "Bob" brachiopods and "Lobelville" corals is not everywhere maintained. For example, at old Rise Mill (locality 36) there is a fairly well developed "Lobelville" coral fauna in the lowermost part of the formation. Another exception may be seen at Sewell's Spring (locality 11) where the *Rhipidium* zone of the "Bob" lies in the uppermost part of the formation, above a well developed "Lobelville" coral zone.

3. Few, if any, of the species that are numerous enough to be representative are confined to a particular horizon.

In view of these objections it appears to the writer that only confusion can result from the continued use of the terms "Beech River," "Bob" and "Lobelville." This is especially true in view of the fact that other workers have used these terms as lithologic units which were in no way connected with the fauna. If it is desirable to retain some name for these facies it would seem that far less confusion would result by simply using crinoid facies, brachiopod facies and coral facies.

CORRELATION

Troost (1835, p. 225) did not give any age for the beds from which he collected *Troosticrinus* and *Calceola* [*Rhizophyllum*] beyond saying that they lay "below the coal measures, so must be regarded as belonging to the upper transition." Safford (1861, p. 206) regarded the Meniscus beds (Brownsport formation) as Niagaran in age and all subsequent writers have placed them and the underlying Dixon in this series. The Decatur has been classified by Ulrich (Wilmarth, 1938, p. 579) as of late Cayugan age, but Pate and Bassler (1908), Springer (1920, p. 5) and Foerste (1935, pp. 184-185; Swartz et al., 1942, chart 3) have placed it in the Niagaran series. The few fossils which the writer has collected from the Decatur indicate that it is closely related in age to the Brownsport and thus belongs in the Niagaran.

In 1903 Foerste did not discuss the age of the Brownsport formation but in 1935 (p. 196) he stated, "The Lockport division of the Niagaran in western Tennessee includes the following formations, in ascending order; Laurel limestone, Waldron shale, Lego limestone, Dixon shale, Beech River formation, Bob formation, Lobelville formation, and Decatur formation." Ball (1939, p. 121) also correlates the Brownsport with the Lockport but the Committee of Stratigraphy of the National Research Council (Swartz et al., 1942, chart 3) regards this formation as older than the Lockport, the time of Brownsport deposition being unrepresented by strata in central and western New York. A comparison of the Brownsport fauna with that of the Lockport as listed by Grabau (1901) and Williams (1919) does not reveal any close similarities. None of the brachiopod or crinoid species which we describe are found in the Lockport and only a few of the Brownsport corals such as *Cladopora*? *reticulata* and *Arachnophyllum pentagonum* are present. Furthermore, such distinctive Brownsport forms as *Troosticrinus reinwardti*, *Rhizophyllum tennesseense* and *Astracospongia meniscus* have not been recorded from the Lockport and seem to show that the two are not correlative.

Pate and Bassler (1908, p. 422) believed that the "Lobelville formation" (here regarded as a coral facies of the Brownsport) was equivalent to the Louisville limestone. Springer (1920, p. 5), Foerste (1935, p. 184, 196) and Ball (1939, p. 121) also correlated these formations on the basis of the similarities of the coral faunas.

In 1885 Davis published a volume of plates which was in part devoted to the corals from the Louisville limestone, but he did not describe any of the species nor did he illustrate any of the internal structure. A study of his illustrations does show that the two coral faunas are very similar. Below is a list of the Brownsport species which are believed to be present in the Louisville; this is based upon a comparison with the figures of Davis.

<i>Davis, 1885</i>	<i>As identified in this report</i>
Cyathophyllum radicula pl. 86, figs. 1-6	Amplexus brownsportensis
Thecia major pl. 34, figs. 1-3	Romingerella major
Thecia swinderana pl. 34, figs. 6, 5(?)	Thecia minor
Plasmopora elegans pl. 1, figs. 11-13	Heliolites tennesseensis
Plasmopora follis pl. 1, figs. 9-10	Plasmopora follis
Favosites forbesi pl. 8, figs. 1-2	Favosites brownsportensis
Favosites cristatus pl. 9, figs. 1-5	Favosites clavatulus
Favosites louisvillensis pl. 9, fig. 6	Favosites louisvillensis?
Coenites verticillata pl. 46, figs. 1-3	Coenites verticillatus
Alveolites louisvillensis pl. 46, figs. 5-6	Planalveolites louisvillensis
Cladopora reticulata pl. 47, figs. 1-2	Cladopora reticulata
Cladopora laqueata pl. 48, figs. 8-9	Cladopora brownsportensis
Eridophyllum rugosum pl. 109, fig. 1	Entelophyllum rugosum
Strombodes pentagonus pl. 121, figs. 2-3	Arachnophyllum pentagonus
Cystiphyllum lineatum pl. 128, figs. 1-4	Cystiphyllum lineatum
Amplexus shumardi pl. 132, fig. 14	Amplexus shumardi

In addition to the coral species listed above, the following Brownsport brachiopods and crinoids have been recorded from the Louisville (Butts, 1915, pp. 90-94; Springer, 1926; Cumings, 1922, pp. 456-457): *Wilsonella saffordi*, *Uncinulus tennesseensis* [*Trigonirhynchia tennesseensis*, *Camarotoechia cedarensis*], *Anisocrinus greeni*, *Macrostylocrinus meeki* and *Melocrinus oblongus*; of perhaps more significance is the presence of such characteristic Brownsport forms as *Troosticrinus reinwardti* and *Astraeospongia meniscus*. The presence of such species as these within the two formations, as well as the considerable number of corals in common, indicate that they are closely related in age.

Foerste (1920, p. 65; 1935, p. 198) correlated the Bainbridge limestone of Missouri with the Brownsport formation. Springer (1920, p. 5) also considered these two formations correlative, finding the following crinoid species present in both: *Pisocrinus benedicti*, *P. gorbyi*, *P. sphericus*, *P. quin-*

quelobus and *P. tennesseensis*. In addition to these species, Flint and Ball (1926, p. 235) also list the following Brownsport forms from the Bainbridge:

Favosites discoideus
Caryocrinites milliganae
Lecanocrinus pisiformis
Pycnosaccus patei
Bilobites bilobus
Strophonella dixonii
Strophonella tenuistriata (not described in this report)
Gypidula [*Sieberella*] *roemeri*
Trematospira simplex (not described in this report)
Dictyonella gibbosa
Merista tennesseensis
Sphaerexochus romingeri (not described in this report)

In 1940 Ball and Grove (p. 383) added the following corals to the above list: *Laccophyllum acuminatum* (not described in this report), *Enterolasma waynense* and *Favosites obpyriformis*.

This list of Brownsport species which have been found in the Bainbridge rather strongly suggests that the two formations are equivalent, although it should be noted that certain important elements of the Brownsport fauna such as *Troosticrinus reinwardti*, *Rhizophyllum tennesseense* and *Astraeospongia meniscus* are absent.

Reeds (1911, p. 262) named the Henryhouse formation in the Arbuckle Mountains and noted that its fauna was similar to that of the Brownsport. Ball (1939, p. 121) followed Reeds in this correlation, but the Committee of Stratigraphy (Swartz et al., 1942, chart 3) shows the Henryhouse as considerably older than the Brownsport. The writer has examined Reeds' Henryhouse collections which are in Peabody Museum, Yale University, and found the following Brownsport species present:

Brachyprion? *glabella*
Strophonella laxiplicata?
Strophonella prolongata
Dictyonella gibbosa
Sieberella roemeri
Merista cf. *M. tennesseensis*
Delthyris saffordi
Coelospira saffordi
Lissatrypa cf. *L. decaturensis*
Parmorthis brownsportensis
Leptaena delicata
Camarotoechia acutiplicata
Bilobites cf. *B. bilobus*
Amplexus shumardi
Cladopora? *reticulata*
Entelophyllum rugosum

Romingerella major
Heliolites cf. H. distans
Favosites louisvillensis
Striatopora gwenensis
Favosites cf. F. clavatulus
Favosites cf. F. beechensis
Enterolasma waynense
Astylospongia praemorsa
Pisocrinus tennesseensis
Pisocrinus quinquelobus

Reeds listed the genus *Calceola* [*Rhizophyllum*] as being present in the Henryhouse but it was not found in the collections examined. The large number of species common to both formations indicates that the two formations are closely related in age.

Recently Croneis and Grubbs (1939, pp. 609-610; Grubbs, 1939, pp. 543-544) described a fauna which was found enclosed in sea balls in the Niagaran dolomites near Chicago. Much of this fauna was new, but it did contain two common Brownsport forms, *Astraeospongia meniscus* and *Troosticrinus reinwardti*. Lowenstam (1940) also found elements of the Brownsport fauna in the Chicago area. His material came from the spoil heaps of the Calumet Sag west of Blue Island and included the following Brownsport species: *Pisocrinus campana*, *P. quinquelobus*, *P. gorbyi*, *P. benedicti*, *Astraeospongia meniscus*, *Atrypa arctostriata* and *Strophonella roemeri*.

The foregoing discussion shows there is considerable faunal evidence upon which to base a correlation of the Brownsport formation with the Louisville, Bainbridge, Henryhouse and certain dolomites in the Chicago area. A number of other correlations have been suggested but the evidence for these is less conclusive.

The Liston Creek formation was named by Cumings and Shrock in 1927 (pp. 75-76) and a year later (1928, pp. 76-84) they published a list of the fauna and gave the stratigraphic relations of the formation. These authors believed the coral fauna to be similar to that of the Louisville and correlated the two formations on that basis. Their faunal lists show the following Brownsport species present: *Amplexus shumardi*, *Cladopora reticulata*, *Eridophyllum* [*Entelophyllum*] *rugosum*, *Thecia* [*Romingerella*] *major*, *Thecia minor*, *Pisocrinus benedicti*, *P. campana* and *P. gorbyi*. A more detailed examination of the Liston Creek fauna is necessary before its relation to the Brownsport can be definitely established.

Savage (Swartz et al., 1942, chart 3) has correlated the Cordell (Michigan and Wisconsin), Bellwood (Illinois) and Cordova (Illinois) with the Liston Creek and Brownsport formations. No description of the faunas of these formations has been found which would permit comparison with the Brownsport fauna.

In 1931 Foerste (p. 173) correlated the Lilley formation of southwestern Ohio with the Louisville limestone which he also regarded as equivalent to

the Brownsport. At that time he listed only two species, *Coenites verticillatus* and *Plasmopora follis*, that have been found in the Brownsport formation. Later Foerste stated that "it is highly doubtful whether any part of the Lilley fauna of the Highland County, Ohio, can be identified as identical with that of the Louisville in Kentucky" (1935, p. 201).

Springer (1926, p. 5) correlated the Cedarville dolomite of Ohio with the *Coccocrinus* zone of the "Beech River formation" (here regarded as a crinoid facies of the Brownsport). Foerste, however, correlated the Cedarville with the Racine dolomite and believed that it was younger than the Brownsport (1920, p. 34; Swartz et al., 1932, chart 3).

Ball (1939, p. 121) has indicated that the Lafferty limestone of the Batesville district in northern Arkansas is equivalent to the Brownsport formation. Miser defined the Lafferty in 1920 and at that time stated: "The stratigraphic relations and lithology suggest that it is of the same age as the Dixon formation of west-central Tennessee, and the evidence of a few fragmentary fossils from the Lafferty limestone is stated by Ulrich not to militate against this correlation."

In the Silurian correlation chart (Swartz et al., 1942, chart 3) the Ekwan River limestone of Canada is correlated with the Brownsport formation. The faunal lists given by Savage and Van Tuyl (1919, pp. 357-359) for that formation do not record any species which are present in the Brownsport, but many of the specimens were identified only as to genera and it may be that a more detailed study would reveal closer affinities.

SUMMARY. The Brownsport strata are of Niagaran age but do not appear to be correlative with Niagaran strata in central and western New York, the time of Brownsport deposition being unrepresented by beds in this area. There is considerable faunal evidence to show that the Brownsport formation is closely related in age to the Louisville limestone, the Bainbridge limestone, and the Henryhouse shale, and to certain Niagaran dolomites in the Chicago area. Correlations with the Cedarville, Liston Creek, Cordell, Bellwood, Cordova, Lilley, Lafferty and Ekwan River formations have also been proposed but there does not appear to be sufficient evidence to justify any definite conclusions.

CATALOGUE OF LOCALITIES AND OF FOSSIL COLLECTIONS

Section 1. Clifton quadrangle; east bank of Tennessee River, 0.7 mile south of junction of Beech Creek with Tennessee River.

1-(63) 0-2' above the Dixon-Brownsport contact.

1-(23) 2-10' above the Dixon-Brownsport contact.

Section 2. Clifton quadrangle; east bank of Tennessee River, 0.4 mile south of junction of Beech Creek with Tennessee River and 0.3 mile north of section 1.

2-(38) 0-40' above the Dixon-Brownsport contact.

2-(135) 40-70' above the Dixon-Brownsport contact.

Section 3. Clifton quadrangle; east bank of Tennessee River, 0.1 mile south of junction of Beech Creek with Tennessee River.

No collections.

Section 4. Perryville quadrangle; short distance east of old Brownsport Furnace, north side of road leading from Cedar Grove Church to Mt. Carmel Church, 2 miles northwest of Mt. Carmel Church.

4-(29) 1-8' above the Dixon-Brownsport contact.

4-(14) 8-23' above the Dixon-Brownsport contact.

4-(32) 23-38' above the Dixon-Brownsport contact.

4-(1) 38' above the Dixon-Brownsport contact.

4-(6) 38-40' above the Dixon-Brownsport contact.

4-(9) 40-56' above the Dixon-Brownsport contact.

4-(44) 56-74' above the Dixon-Brownsport contact.

Section 5. Bath Springs quadrangle; west bank of Tennessee River, 0.7 mile north of Bob's Landing, 0.4 south of Double Island.

Section 6. Bath Springs quadrangle; west bank of Tennessee River, 0.5 mile north of Bob's Landing, 0.3 mile south of Section 5.

6-(30) 5-10' above Dixon-Brownsport contact.

Section 7. Bath Springs quadrangle; west bank of Tennessee River, 0.5 mile south of Bob's Landing.

7-(11) 50' above the Dixon-Brownsport contact.

Section 8. Bath Springs quadrangle; south bank of Tennessee River, 0.5 mile west of Clifton.

8-(58) 35-50' above the Dixon-Brownsport contact.

8-(57) 65-90' above the Dixon-Brownsport contact.

Section 9. Bath Springs quadrangle; north side of State Highway 114, 2¼ miles southeast of Bath Springs Church.

9-(3) Dixon-Brownsport contact not well exposed; collection approximately 50-60' above this contact.

9-(18) Approximately 60-70' above the Dixon-Brownsport contact.

Section 10. Clifton quadrangle; Sewell's Spring; on east side of Whiteoak School road, 0.4 mile north of Whiteoak School.

10-(26) 5-10' below the Decatur-Brownsport contact.

Section 11. Clifton quadrangle; near Sewell's Spring, 0.1 mile south of section 10.

11-(36) Glade 14-56' below the Decatur-Brownsport contact.

- 11-(56) Coarse-grained limestone ledge 12' below Decatur-Brownsport contact.
- Section 12.* Clifton quadrangle; near Sewell's Spring, 0.2 mile north of Section 10.
12-(27) Glade 7-27' below the Decatur-Brownsport contact.
- Section 13.* Jeannette quadrangle; Mousetail Bluff, east side of Tennessee River, just north of Mousetail Landing and 0.5 mile south of Lick Creek mouth.
13-(49) 0-15' above the Dixon-Brownsport contact.
13-(68) 50-60' above the Dixon-Brownsport contact.
13-(41) 65-85' above the Dixon-Brownsport contact.
- Section 14.* Jeannette quadrangle; Lady Finger Bluff, east side of Tennessee River, 0.9 mile north of Mousetail Landing and 0.4 mile north of Lick Creek mouth.
14-(42) 0-8' below Decatur-Brownsport contact.
14-(127) Limestone ledge 19' below Decatur-Brownsport contact.
14-(134) Coarse-grained, gray limestone, 40' below Decatur-Brownsport contact.
- Section 15.* Clifton quadrangle; 0.3 mile east of confluence of Beech Creek and Little Beech Creek.
15-(59) 2-6' above the Dixon-Brownsport contact.
15-(47) 68-78' above the Dixon-Brownsport contact.
- Section 16.* Clifton quadrangle; southwest side of Beech Grove School road, 0.5 southeast of Beech Grove School.
16-(28) Glade 0-55' above the Dixon-Brownsport contact.
16-(31) 55-60' above the Dixon-Brownsport contact.
- Section 17.* Northwestern corner of Clifton quadrangle; 0.6 mile north of Lego School.
17-(62) 12-35' above Dixon-Brownsport contact.
17-(24) 50-68' above the Dixon-Brownsport contact.
- Section 18.* Perryville quadrangle; Blue Mound Glade, 0.2 mile north of road leading from Cedar Grove Church to Mt. Carmel Church, 0.8 mile northeast of Cedar Grove Church.
18-(2) Glade 30-45' above the Dixon-Brownsport contact.
18-(13) Glade 45-50' above the Dixon-Brownsport contact.
18-(66) Glade 64-74' above Dixon-Brownsport contact.
18-(65) Glade 74-84' above Dixon-Brownsport contact.
- Section 19.* Eagle Creek quadrangle; north side of Federal Highway 64, 1.7 miles southeast of junction of road leading south to Beckman Branch.
19-(19) Neither Dixon nor Decatur are exposed in this section, entire section in Brownsport; this collection 13-18' above base of section.
19-(52) Glade 18-20' above base of section.
19-(61) Glade 20-25' above base of section.
19-(16) Limestone ledge 50' above base of section.
19-(43) Glade 50-70' above base of section.
- Section 20.* Eagle Creek quadrangle; north side Federal Highway 64, 0.8 mile southwest of junction of road leading south to Beckman Branch.
20-(22) Neither Dixon nor Decatur exposed in this section. About 35' of beds exposed in a glade.
- Section 21.* Eagle Creek quadrangle; east side of State Highway 114, 2½ miles south of Clifton.
21-(25) Dixon not exposed in this section. About 20' of beds exposed as a glade.

- Section 22.* Bath Springs quadrangle; on road leading to Bob's Landing, 0.9 mile from Bob's Landing.
 22-(15) Glade 77' above Dixon-Brownsport contact.
- Section 23.* Bath Springs quadrangle; east side of State Highway 69, 0.1 mile north of junction with State Highway 114.
 23-(64) Glade 33-42' above Dixon-Brownsport contact.
 23-(21) Glade 50-85' above Dixon-Brownsport contact.
- Section 24.* Bath Springs quadrangle; north side of State Highway 114, 0.1 mile east of Bath Springs Church.
 24-(12) Glade 20-42' above Dixon-Brownsport contact.
- Section 25.* Perryville quadrangle; north side of road leading from Cedar Grove Church to Mt. Carmel Church, 0.8 mile east of Cedar Grove Church; 0.2 mile south of section 18.
 25-(4) Glade 30-35' above Dixon-Brownsport contact.
- Section 26.* Northwestern corner of Clifton quadrangle; east bank of Tennessee River, 0.5 mile south of junction of Short Creek with Tennessee River.
 26-(79) 28-30' above Dixon-Brownsport contact.
 26-(81) 65-100' above Dixon-Brownsport contact.
 26-(80) 100' above Dixon-Brownsport contact.
- Section 27.* Northwestern part of Clifton quadrangle; east bank of Tennessee River, 0.2 mile north of junction with Short Creek.
 27-(119) 10-20' above the Dixon-Brownsport contact.
 27-(87) 20-40' above Dixon-Brownsport contact.
 27-(75) 61-69' above Dixon-Brownsport contact.
 27-(95) 75-95' above Dixon-Brownsport contact.
- Section 28.* Pope quadrangle; east side of road from Pope to Clifton, 1.4 miles south of Hall School.
 28-(74) This is a glade formed on the Brownsport beds without any Decatur or Dixon exposed. The glade is probably in the upper 30' of the Brownsport.
- Section 29.* Bath Springs quadrangle; road leading south from State Highway 114 to Gwens Landing, 0.3 mile north of Gwens Landing.
 29-(93) Glade 2-10' above Dixon-Brownsport contact.
 29-(71) Glade 10-18' above Dixon-Brownsport contact.
 29-(77) Glade 18-25' above Dixon-Brownsport contact.
 29-(72) Glade 25-33' above Dixon-Brownsport contact.
- Section 30.* Thurman quadrangle; north bank of Tennessee River, 0.6 mile southwest of Pleasant Point.
 30-(78) 0-10' above the Dixon-Brownsport contact.
 30-(83) Glade 30-50' above Dixon-Brownsport contact.
- Section 31.* Pope quadrangle; north side of road leading east from Hall School, paralleling Marsh Creek, 0.2 mile north of Sutton School.
 31-(96) 1-20' below Decatur-Brownsport contact.
- Section 32.* Pope quadrangle; east side of road leading south from Sutton School, 0.9 mile south of Sutton School.
 32-(107) Glade 3-7' above Dixon-Brownsport contact.
 32-(115) Coarse-grained, gray limestone 39-43' above Dixon-Brownsport contact.
 32-(101) Glade 53-83' above Dixon-Brownsport contact.
- Section 33.* Bath Springs quadrangle; west bank of Tennessee River, 0.2 mile north of Bob's Landing.
 33-(100) 37-62' below Decatur-Brownsport contact.

- 33-(122) 62-65' below Decatur-Brownsport contact.
- Section 34.* Leatherwood quadrangle; east side of State Highway 13, 1 mile east of Flat Woods.
- 34-(117) Decatur limestone is absent in this area. Collection from the Brownsport 1-17' below Hardin sandstone.
- Section 35.* Linden quadrangle; southeast bank of Buffalo River, 0.7 mile east of bridge where State Highway 13 crosses Buffalo River.
- 35-(98) Decatur absent in this area, Hardin sandstone resting directly upon Brownsport. This collection from the Brownsport 5-30' below Hardin-Brownsport contact.
- 35-(97) 30-33' below contact of Hardin sandstone with Brownsport.
- Section 36.* Linden quadrangle; 0.2 mile north of State Highway 20, 0.4 mile east of junction of State Highways 20 and 13, 0.2 mile south of Old Rise Mill.
- 36-(105) Glade 1-16' above Dixon-Brownsport contact.
- 36-(106) Glade 16-42' above Dixon-Brownsport contact.
- 36-(76) Glade 42-62' above Dixon-Brownsport contact.
- 36-(82) Coarse-grained, gray limestone 62-71' above Dixon-Brownsport contact.
- 36-(137) Limestone ledge 75' above Dixon-Brownsport contact.
- Section 37.* Linden quadrangle; Old Rise Mill, 0.5 mile east of junction of State Highways 13 and 20, 0.1 mile south of Buffalo River.
- Section 38.* Lobelville quadrangle; 1 mile north of Lobelville, 100' east of Gilmore Bridge on southwest bank of Buffalo River.
- 38-(90) 17-30' below Decatur-Brownsport contact.
- Section 39.* Perryville quadrangle; east side of road leading from Perryville to Decaturville, 1.2 miles south of Perryville.
- 39-(103) Glade 3-13' above the Dixon-Brownsport contact.
- 39-(91) Glade 13-36' above Dixon-Brownsport contact.
- 39-(121) Glade 36-38' above the Dixon-Brownsport contact.
- 39-(129) Glade 38-58' above Dixon-Brownsport contact.
- 39-(73) Glade 58-72' above Dixon-Brownsport contact.
- 39-(118) Glade 73-95' above Dixon-Brownsport contact.
- Section 40.* Perryville quadrangle; southwest side of road leading east from Webbs Landing, 0.7 southeast of Landing.
- 40-(104) Glade 12-14' above Dixon-Brownsport contact.
- 40-(123) Glade 14-46' above Dixon-Brownsport contact.
- 40-(136) Glade 45-55' above Dixon-Brownsport contact.
- Section 41.* Jeannette quadrangle; east bank of Tennessee River, 0.2 mile north of junction with Lick Creek; Lady Finger Bluff.
- 41-(86) Glade 1-30' below Decatur-Brownsport contact.
- 41-(88) Limestone ledge 20' below Decatur-Brownsport contact.
- Section 42.* Martins Mills quadrangle; north side of Indian Creek, 0.2 mile west of bridge where road from Martins Mills to Houston crosses Indian Creek.
- 42-(93) Glade 5-50' above Dixon-Brownsport contact.
- Section 43.* Martins Mills quadrangle; section crosses road leading from Martins Mills to Lutts, 1.8 miles south of Martins Mills.
- 43-(94) Decatur absent in this area; collection from a glade on the Brownsport beds, 1-9' below Hardin sandstone-Brownsport contact.
- Section 44.* Perryville quadrangle; east side of road leading north from Gumdale; 1.7 miles south of Fishers Landing.
- 44-(133) Glade 21-31' above Dixon-Brownsport contact.

- Section 45.* Martins Mills quadrangle; south side of Indian Creek, 0.7 mile east of bridge where road from Martins Mills to Houston crosses creek.
45-(120) 22-62' above Dixon-Brownsport contact.
- Section 46.* Chestnut Grove quadrangle; 0.1 mile north of Coon Creek, 0.8 mile southeast of confluence of Coon Creek and Buffalo River.
46-(84) 10-27' below contact of Decatur-Brownsport.
46-(114) 27-37' below Decatur-Brownsport contact.
46-(110) 37-41' below Decatur-Brownsport contact.
- Section 47.* Chestnut Grove quadrangle; southwest bank of Cane Creek, 0.2 mile west of Craig School, 0.1 mile south of bridge where State Highway 50 crosses Cane Creek.
47-(85) 0-17' below Decatur-Brownsport contact.
- Section 48.* Pine View quadrangle; road paralleling Lick Creek, between Union Church and Dixon Church, 0.4 mile east of Union Church.
48-(108) Glade 16-38' above the Dixon-Brownsport contact.
48-(130) Glade 40-48' above Dixon-Brownsport contact.
48-(112) Glade 48-69' above Dixon-Brownsport contact.
48-(113) Glade 85-107' above Dixon-Brownsport contact.
- Section 49.* Bath Springs quadrangle; 0.3 mile north of State Highway 114, 1 mile northeast of Bath Springs Church.
49-(109) Neither the Dixon nor the Decatur exposed in this section which is entirely in the Brownsport. This collection from a glade 24-36' above base of section.
49-(111) Limestone ledge 37' above base of section.
49-(131) Glade 42-60' above base of section.
49-(132) Glade 60-85' above base of section.
- Section 50.* Perryville quadrangle; Old Tucks Mill, south bank of Beech River, 1.3 miles north of Decaturville; 0.3 mile southwest of bridge where State Highways 69 and 100 cross Beech River.
50-(70) Argillaceous limestone ledge 35 to 40' below Brownsport-Decatur contact.
- Section 51.* (Not shown on map, fig. 1). West side of Federal Highway 70, 2.5 miles west of Pegram, Tenn.
51-(69) 15-25' above the Dixon-Brownsport contact.
- Section 52.* Martins Mills quadrangle; north of Indian Creek, on north side of road leading from Houston to old Gant homestead; about 1 mile west of Houston. No collections made here.
- Section 53.* Eagle Creek quadrangle; south side of U. S. Highway 64, about 1½ miles southwest of junction with State Highway 114.

DESCRIPTION OF GENERA AND SPECIES

PHYLUM BRACHIOPODA

Order PROTREMATA

Superfamily DALMANELLACEA

Genus *Parmorthis* Schuchert and Cooper, 1931

Parmorthis brownsportensis Amsden, n. sp.

Plate I, figs. 1-6

Orthis elegantula Roemer, 1860 (p. 62, pl. 5, fig. 7; non Dalman, 1828, p. 117, pl. 2, fig. 6).

DESCRIPTION. Outline subelliptical; longer than wide. Lateral profile plano-convex; cardinal areas meeting at an angle slightly less than 90 degrees; orthocline. Ventral valve strongly arched, rising above the hinge line for a distance equal to about half the length of the shell; beak strongly curved, arching over the dorsal valve, extending posterior to the hinge line for a distance equal to approximately one-sixth of the length of the shell. Dorsal valve only faintly arched; divided by a shallow sulcus which begins just anterior to hinge line, becoming broad at the anterior margin. Surface covered with fine multicostellae; about 15 costellae in a distance of 5 mm. An average specimen measures 14 mm. long by 12 mm. wide; two of the largest individuals in the collections reach 20 mm. in length.

This species has the typical internal characters of the genus as shown in plate I, figures 4-6. In most specimens the delthyrium does not show a covering plate but a few individuals possess a deltidium which does not appear to be open at the apical end. Test punctate.

DISCUSSION. This species differs from *P. waldronensis* (Foerste, 1917, p. 245) in being more elliptical in outline, in having the ventral valve more strongly arched, and in having the beak extended more posterior to the hinge line. *P. brownsportensis* is also the smaller.

P. brownsportensis is most similar to the European species *P. elegantula*. It is about the same size as *P. elegantula* but differs from that species in the more elliptical outline, the more sharply arched ventral valve, the more incurved beak and the flatter dorsal valve.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. Very abundant and widespread, distributed throughout the formation. Collections at the following localities and horizons: 4-(1), (6), (9), (14), (29), (44); 6-(30); 7-(11); 9-(3); 11-(36); 13-(41); 15-(47); 17-(24); 18-(2), (13); 19-(19), (52); 22-(15); 24-(12); 25-(4); 26-(81); 27-(87); 29-(72), (71), (77); 36-(106); 39-(91), (73), (118), (129), (103), (121); 40-(123), (136); 42-(92); 44-(133); 49-(109).

Genus *Mendacella* Cooper, 1930*Mendacella cliftonensis* Amsden, n. sp.

Plate I, figs. 7-11

Orthis hybrida Roemer, 1860 (p. 63, pl. 5, fig. 6; non Sowerby, 1839, p. 630, pl. 13, fig. 11).

DESCRIPTION. Shell subcircular to subquadrante in outline with anterior margin rather straight, especially in adult shells; wider than long. Lateral profile biconvex, ventral valve having the greater convexity. Hinge line approximately two-thirds the greatest width of the shell. Ventral valve moderately convex; umbo not sharply arched, rising above the hinge line for a distance equal to about one-third the length of the valve; slight flattening anterior to the umbo; beak small, sharp, only slightly arched over the dorsal valve. Dorsal valve slightly less convex than ventral, with a gentle flattening anterior to the umbo. Surface multicostellate, the costellae being low and rounded and numbering about 15 in a space of 5 mm. A specimen of average size measured 13 mm. wide by 11 mm. long.

This species has the typical characteristics of the genus *Mendacella*. The lateral profile is subequally biconvex, differing from *Rhipidomella* in that the ventral valve has the greater convexity. The interior of the ventral valve shows rather strong, subparallel dental plates which are extended forward as ridges on the margins of the muscle scars (pl. I, fig. 11). Diductor scars are long, narrow and not semiflabellate as in *Rhipidomella*. The dorsal valve has stout, bluntly pointed brachiophores. Several well preserved specimens show a small, concave fulcral plate. Plate I, figure 10, shows a specimen with the left hand fulcral plate preserved. This figure also shows the small, blunt cardinal process.

DISCUSSION. This species most closely resembles *M. ubertis* (Billings, 1866, p. 42) but differs in having a less sharply arched umbo. It has about the same number of costellae as *M. uberis* but they are not as elevated or as sharply defined. Roemer identified this species as *Orthis hybrida* (*Rhipidomella hybrida*) Sowerby but it is less convex than the European species and has less prominent costellae.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. Common and widespread, distributed throughout the formation. Collections from the following localities and horizons: 1-(23); 4-(1), (6); 7-(11); 9-(3); 11-(56); 18-(2), (13); 19-(19); 22-(15); 23-(21); 24-(12); 25-(4); 27-(75); 28-(74); 30-(78); 33-(100); 40-(136); 49-(131), (109).

Mendacella? *lenticularis* (Foerste)

Plate I, figs. 20-21

Rhipidomella lenticularis Foerste, 1903 (p. 711; 1909B, p. 72, pl. 2, figs. 28A, B).*Mendacella?* *lenticularis* (Schuchert and Cooper, 1932, p. 127).

DESCRIPTION. Shell subcircular in outline with hinge line less than greatest width of shell. Surface multicostellate, about 12 to 15 in a distance of 5 mm. Size of largest individual approximately 26 mm. wide and 23 mm. long.

Ventral interior possessing dental plates which extended in a low, subparallel ridge along the muscle scars (pl. I, fig. 21). No dorsal interiors seen.

DISCUSSION. The specimens are all somewhat crushed and therefore it is not possible to determine which valve had the greater convexity. It is not certain that

this species should be referred to the genus *Mendacella* although the one ventral interior which the writer has seen would suggest this.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee; only 10 specimens found, ranging from 20 to 77 feet above the Dixon-Brownsport contact. Collections from localities 4-(44); 9-(3); 18-(2); 22-(15).

Genus *Isorthis* Kozłowski, 1929

Isorthis arcuaria (Hall and Clarke)

Plate I, figs. 12-16

Orthis (*Dalmanella*) *arcuaria* Hall and Clarke, 1892 (pp. 224, 341, pl. 5c, figs. 20, 21).

Isorthis arcuaria (Schuchert and Cooper, 1932, p. 150, pl. 21, figs. 21, 23, 32).

DESCRIPTION. Subcircular in outline. Lateral profile subequally biconvex, ventral valve with the greater convexity. Ventral beak rather small, only slightly incurved. Dorsal valve with shallow sulcus. Surface multicostellate with about 20 costellae in a distance of 5 mm. Average individual 11 mm. long by 11 mm. wide; one large, rather crushed specimen 18 mm. wide and 18 mm. long.

The ventral interior shows the deeply impressed muscle field, bilobed in front, which is characteristic of the genus *Isorthis* (pl. I, fig. 15). The blade-like brachio-phores are shown in plate I, figure 16. Test punctate.

DISCUSSION. This species is easily crushed and it is therefore rather difficult to find perfect specimens, especially of mature individuals.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. Common and widespread, distributed throughout the formation. Collections from the following locations and horizons: 4-(6), (9), (14), (29); 9-(3); 12-(27); 13-(41); 17-(24); 18-(2); 19-(19), (52); 21-(25); 22-(15); 25-(4); 26-(79); 28-(74); 29-(93); 39-(103), (73), (91), (129); 40-(123), (104); 44-(133); 48-(108).

Genus *Bilobites* Linnaeus, 1775

Bilobites cf. *B. bilobus* (Linnaeus)

Plate I, figs. 17-19

Anomia biloba Linnaeus, 1767 (p. 1154).

DISCUSSION. The Brownsport collections include only three specimens of a small species of *Bilobites* whose shape is well shown in figures 17-19 of plate I. The Schuchert collections in Peabody Museum include a suite of six closely similar specimens from an undefined locality in the Brownsport formation. This form appears to be identical with one that occurs in the Waldron shale. It is very similar to *B. bilobus* Linnaeus, but when compared directly with specimens from Gotland presumed to be typical of Linnaeus species, it displays slight but constant differences in the shape of the median sulcus which is deeper and more broadly rounded in both valves of the specimens from Gotland.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. (For complete geographic and stratigraphic distribution of *B. bilobus* in America see Bassler, 1915, p. 126.) Specimens in this collection from the following localities and horizons: 19-(19); 23-(21); 40-(123).

Superfamily ORTHACEA

Genus *Schizorammina* Foerste, 1912(Homonym, *Schizonema* Foerste, 1909B)*Schizorammina fissiplica* (Roemer)

Plate I, figs. 22-25

Orthis fissiplica Roemer, 1860 (p. 64, pl. 5, figs. 5a, 5b).*Hebertella* (*Schizonema*) *fissiplica* (Foerste, 1909B, p. 79, pl. 3, fig. 54).*Orthostrophia* (*Schizorammina*) *fissiplica* (Bassler, 1915, p. 925).*Schizorammina fissiplica* (Schuchert and Cooper, 1932, p. 87).

DESCRIPTION. Transversely subelliptical in outline; lateral profile planoconvex with ventral valve convex, dorsal valve almost flat. Ventral palintrope making an angle of approximately 90 degrees with the plane of the valve margin. Fascicostellate, with the outer margin possessing about 30 costellae. Costellae bluntly angular and fasciculate, each increasing in size toward the margin of shell in spite of frequent fission. In addition, surface marked by fine concentric lirae, sharp and conspicuous in the furrows, obscure across the summits of the costellae. Width of an average specimen 15 mm., length 12 mm. Ventral interior as shown in plate I, fig. 25. Test impunctate.

DISCUSSION. Foerste (1909B, p. 79) in discussing this species states that the ventral palintrope makes an angle of about 110 degrees with the valve margin. As noted above the angle seems to be closer to 90 degrees. Foerste also notes that in Roemer's (1860, pl. 5, fig. 5b) lateral view of *S. fissiplica* the curvature is reversed, a feature which Foerste thinks is due to crushing. Also, the same figure shows the ventral palintrope angle as 40 or 50 degrees which he thinks should be much greater. The specimens under examination confirm Foerste's observations.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. Common and widespread, distributed throughout the formation. Specimens in this collection from the following localities and horizons: 4-(1), (9), (14); 13-(49); 19-(19); 21-(25); 26-(81); 29-(72); 36-(105); 39-(73), (103), (121); 40-(123); 42-(93); 44-(133); 50-(70).

Genus *Orthostrophia* Hall, 1863*Orthostrophia brownsportensis* Amsden, n. sp.

Plate I, fig. 26; Plate XXXIV, figs. 1, 4

DESCRIPTION. The shell is subquadrate in outline with the hinge line slightly less than the greatest width. The lateral profile is biconvex; ventral area apsacline, slightly longer than dorsal. Ventral valve with a rather sharp fold at the posterior end, extending anteriorly for a distance of about 10 mm. and then being replaced by a low, broad sulcus. Dorsal valve with a narrow, sharp sulcus at the posterior end which extends forward for 10 mm. and is then replaced by a broad, low, poorly defined fold. Surface multicostellate, with 15 or 16 costellae occupying a distance of 10 mm. at the anterior end. Costellae crossed by elevated, concentric growth lines. Greatest width of shell 29 mm., 25 mm. long and 15 mm. thick. No interiors seen.

DISCUSSION. Foerste (1909B, p. 74, pl. 4, fig. 65) described the species *O. dixoni* from the Brownsport formation. The writer has examined the type specimen of

this species and found it consists of only a fragment of one valve. This does not appear to have the same size and shape as our specimen although accurate comparison is difficult in the absence of any better material.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. One specimen from locality 18-(2).

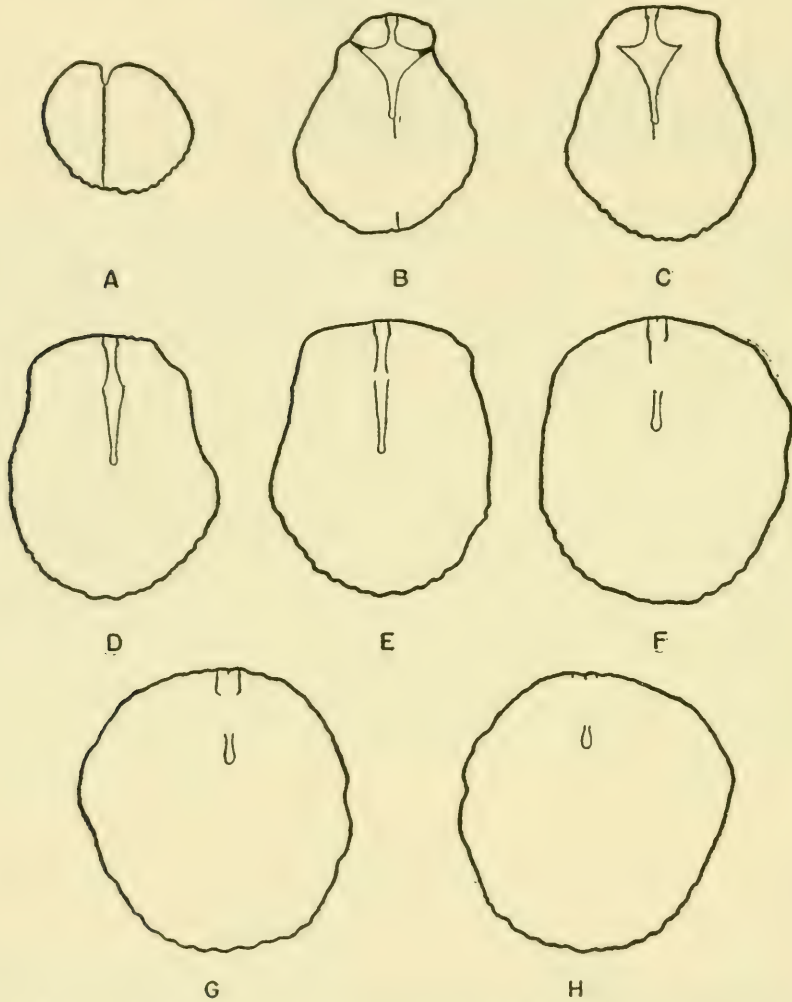


Figure 23. Serial sections A to H showing the internal structure of *Rhipidium pingue* (x 1). Distance from posterior tip of spondylium:

- | | |
|----------|------------|
| A— 1 mm. | E—16 mm. |
| B— 6 mm. | F—20 mm. |
| C— 8 mm. | G—22.5 mm. |
| D—12 mm. | H—24 mm. |

Locality 11-(56); Y.P.M. 17544.

Superfamily PENTAMERACEA

Genus *Rhipidium* Schuchert and Cooper, 1931*Rhipidium pingue* Amsden n. sp.

Plate III, figs. 1-2; Plate IV, figs. 1-4; Text figs. 23, 24

DESCRIPTION. Shell large, suboval in outline, slightly constructed just anterior to the umbo. Lateral profile strongly biconvex, convexity of valves about equal. Ventral beak small, strongly hooked, arched over the dorsal valve but not in conjunction with it. Ventral valve commonly showing a pronounced flattening at the posterior end. Shell plicate, about 25 plications on the anterior margin of the ventral valve and 23 to 25 on the dorsal valve; plications not present on the lateral margins and not extending to the anterior end of the shell. The holotype measures 65 mm. wide and 65 mm. long; one of the largest ventral valves in our collection measures 75 mm. long. Shell fibrous, impunctate.

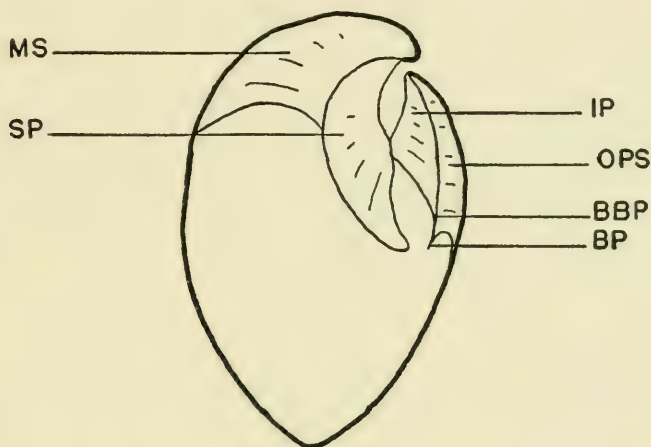


Figure 24. Longitudinal section of *Rhipidium pingue* (x 1). Reconstructed from the serial sections shown in fig. 26. BP—brachial process; BBP—base of brachial process; IP—inner plate; MS—median septum; OPS—outer plate and septum; SP—spondylium.

This species commonly displays an unusual sequence of growth stages. The shell is gently biconvex and oval in outline until it is 30 or 40 mm. long; then rapidly develops steep lateral margins and becomes deeply biconvex; after it is approximately half grown the lateral margins again expand. As a result the shells appear to have a broad construction (more marked on the ventral than on the dorsal valve) that sets off a rather flattened umbonal area from the more expanded anterior part of the shell.

In the ventral interior the spondylium is long, exceedingly deep and narrow and thin-walled (text fig. 23). It is supported by a duplex septum for about half its length.

In the dorsal interior the septal plates are discrete, diverging slightly, each consisting of three elements: (1) an outer plate, (2) an inner plate and (3) the

brachial process (text figs. 23, 24). The outer plates are erect septa arising from the floor of the valve and are a little thicker than the inner plates from which they are separated by a slight flexure or a faint ridge. The inner plates continue upwards from the inner edge of the outer plates; at the posterior end of the shell they curl outward to meet the margins. The brachial processes are slender blades that arise along the juncture of the outer and inner plates and extend forward beyond them for a short distance.

DISCUSSION. Schuchert and Cooper (1931, p. 249; 1932, p. 180) proposed the genus *Rhipidium* for costate shells which have the outline, profile and interior structure of *Pentamerus*. The internal structure of *R. pingue* is quite similar to *Pentamerus* although the ventral spondylium may be somewhat more narrow and deep than is common in this genus. Externally it is more strongly biconvex and has the ventral beak more sharply hooked than does *R. knappi* (genotype; Hall and Whitfield 1872).

R. pingue is much larger than the Brownsport species *Conchidium* (?) *lindense* and *C* (?) *legoense* described by Foerste (1903, p. 711; 1909B, pl. 2, figs. 25A, B, 36A, B). The lateral outline is somewhat similar to that of *Conchidium nettelrothi* (*Pentamerus knighti* Nettelroth, 1889, p. 57, pl. 29, figs. 1, 2, 17), but *R. pingue* is much larger.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. This species has been found at 5 localities: 11-(56); 28-(74); 38-(90); 43-(94); 46-(114). It is not common except at locality 11 where it is so abundant that it forms a coquina. It is found in the upper 30 feet of the Brownsport formation; the only possible exception to this is at localities 28-(74) and 43-(94) where neither the underlying Dixon nor the overlying Decatur formation is present and therefore the exact stratigraphic position is not known.

Rhipidium sewellense Amsden, n. sp.

Plate II, figs. 10-13; Plate III, figs. 3-5; Text fig. 25

DESCRIPTION. Shell suboval in outline. Lateral profile biconvex, convexity of valves about equal. Ventral beak small, only slightly arched over the dorsal valve. Ventral valve commonly showing a flattening of the umbo. Shell plicate, about 25 plications on ventral and 25 on dorsal valve; plications not present on lateral margins. A specimen of average size measures 58 mm. wide, 56 mm. long.

There is a slight constriction of the valves just anterior to the umbones; however, this is not as marked as it is in *R. pingue*.

The spondylium in the ventral valve is narrow and deep although not as conspicuously so as in *R. pingue*. In the dorsal valve the septal plates have an arrangement closely similar to that of *R. pingue*. These plates extend to within 4 mm. or so of the anterior tip of the spondylium. In the sectioned specimen (fig. 25) the brachial processes were not observed to extend as free plates beyond the septal plates.

DISCUSSION. This species differs from *R. pingue* in its small size and in being less strongly biconvex. Furthermore the mid-length constriction of the valves is not as marked in *R. sewellense*. It is similar in outline and lateral profile to *R. knappi* (Hall and Whitfield, 1872, p. 184; 1875B, pl. 10, figs. 10-12), but is much smaller than the specimen figured by Hall and Whitfield. *R. sewellense* is considerably larger than *Conchidium* (?) *legoense* (Foerste, 1903, p. 711; 1909B, p. 69, pl. 2, figs. 36A, B).

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. This spe-

cies has been found only at localities 1-(56) and 26-(80). At 11-(56) it is found associated with *R. pingue* in considerable numbers. At both localities it occurs in the upper 30 feet of the formation.

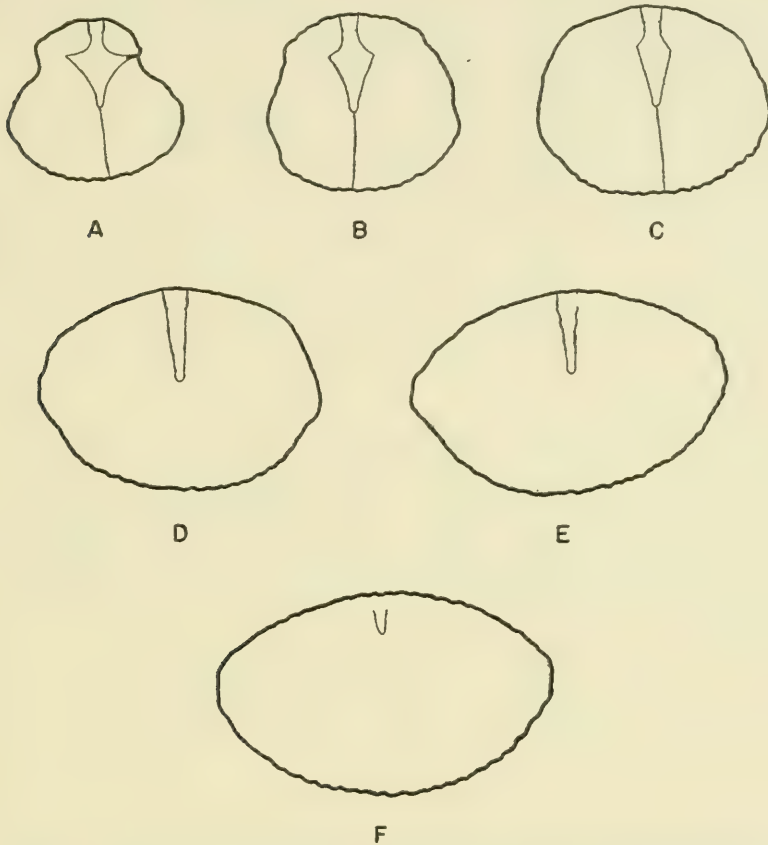


Figure 25. Serial sections A to F showing the internal structures of *Rhipidium sewellense* (x 1). Distance from beak:

A— 8 mm.	D—16 mm.
B—10 mm.	E—18.5 mm.
C—11 mm.	F—22 mm.

Locality 11-(56); Y.P.M. 17599.

Genus *Sieberella* Oehlert, 1887

Sieberella roemeri Hall and Clarke

Plate II, figs. 1-4

Pentamerus galeatus Roemer, 1860 (p. 73, pl. 5, figs. 11a, b; non Dalman 1828, p. 46, pl. 5, fig. 4).

Sieberella roemeri Hall and Clarke, 1892 (p. 247, pl. 2, fig. 6).

DESCRIPTION. Shell galeatiform with hinge line less than greatest width of shell. Lateral profile biconvex, ventral valve with greatest convexity. Ventral beak sharply incurving over the dorsal valve. Shallow sulcus on dorsal valve beginning

about the middle of the valve; low fold on ventral valve beginning anterior to the umbo. Surface marked with low, rounded plications, arising in front of the umbones; commonly 3 plications in the sulcus and 4 on the fold and 3 or 4 on each lateral slope, the outer ones becoming progressively fainter and leaving an undefined, unplicated lateral margin. The figured specimen (pl. II, figs. 1-3), one of the largest in the collection, measures 24 mm. wide and 24 mm. long; an average specimen measures 18 mm. wide by 18 mm. long.

Several etched specimens show this species to possess the characteristic internal structures of the genus *Sieberella*. The dorsal septa unit before reaching the floor of the valve as shown in figure 4 of plate II.

DISCUSSION. Roemer shows the posterior portion of the ventral valve as rather small and pinched. The writer has examined a large number of specimens obtained from the same general region in which Roemer made his collections and all show this portion of the shell as broader and more rounded. This difference may be due to the fact that the individual illustrated by Roemer is an unusual one or to an error in the drawing for his illustration. Hall and Clarke's figure closely resembles the specimens studied.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee; Henryhouse shale of central Oklahoma. Common and widespread in the Brownsport formation and found distributed throughout the formation. Collections from the following localities and horizons: 4-(1), (6), (9), (14), (32), (44); 7-(11); 9-(3), (18); 18-(2), (13); 19-(16); 24-(12); 25-(4); 28-(74); 30-(78), (83); 31-(96); 32-(101); 33-(100); 35-(98); 38-(90); 39-(103); 40-(136); 41-(86); 47-(85); 48-(112); 49-(109). At localities 28-(74) and 38-(90) it is found associated with *Rhipidium*.

Genus *Anastrophia* Hall, 1867

(Homonym, *Brachymerus* Shaler, 1865)

Anastrophia acutiplicata Amsden, n. sp.

Plate II, figs. 5-9

DESCRIPTION. Shell globular, hinge line less than greatest width of shell. Lateral profile biconvex, dorsal valve with greater convexity. Ventral beak small, incurved over the dorsal. Dorsal valve with a fold beginning in front of the umbo, increasing in height to the front margin; 4 or 5 sharply angular plications on fold. Ventral valve with sulcus beginning just anterior to the umbo, becoming quite deep and distinct in front part of shell and bearing 3 or 4 plications. Surface with high, sharply angular plications which become obsolescent on lateral margins; usually one plication intercalated on each side of the fold and sulcus; about 18 plications on anterior margin of dorsal valve, 19-20 on ventral valve. Average individual measures 16 mm. wide, 12 mm. long and 11 mm. deep.

Two etched specimens show this species to have an internal structure very similar to that of *A. verneuli* (genotype, Hall, 1857, p. 104, figs. 1, 2; Schuchert and Cooper, 1932, p. 169, pl. 25, figs. 14-15, 19, 33-36, 38-42). The ventral valve possesses a spondylium which is sessile at the posterior end but supported by a median septum in front. The brachial supports are rather stout with their posterior ends curving laterally to unite with the walls of the valve. The septal plates are discrete and subparallel and extend forward from the brachial supports for about one-third the length of the valve. The alar plates lie outside of the septal plates. At their posterior end they are united with the septal plates but anteriorly they curve laterally and extend for a short distance as free plates.

DISCUSSION. This species most closely resembles *A. internascens*; however, a comparison with specimens from the Waldron shale (type locality of *A. internascens*) shows several consistent differences. The fold and sulcus in *A. acutiplicata* are more prominent and sharply defined than in *A. internascens*. The plications of *A. acutiplicata* are sharply angular while in the Waldron species they are more rounded. Furthermore the plications of *A. internascens* are somewhat broader, there being about 4 plications in a distance of 5 mm., as against 5 or 6 in a distance of 5 mm. in the Brownsport species.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. Uncommon; 9 specimens found at localities 18-(2) and 9-(3) in a zone 30 to 60 feet above the Dixon-Brownsport contact.

Superfamily STROPHOMENACEA

Genus *Strophonella* Hall, 1879

Strophonella prolongata Foerste

Plate V, figs. 8-10

Strophonella prolongata Foerste, 1903 (p. 710; 1909B, p. 85, pl. 2, figs. 23A, B).

DESCRIPTION. The shell is subtriangular in outline and fully twice as wide as long. In profile it is thin, resupinate and strongly geniculate. The dorsal valve is concave for a distance of 8 or 9 mm. from the beak, then reverses its curvature and at 10 or 11 mm. bends sharply ventrad so that the anterior slope is nearly at right angles to the visceral disc. The surface bears sharp costellae separated by wider and rounded interspaces. Most of the costellae are simple and tend to increase in size toward the margin of the shell where 9 or 10 occupy a space of 5 mm., but a few new ones may be added by intercalation. Width of a typical shell is 28 mm.; length 15 mm. No interiors have been seen but the cardinal margins clearly show that denticulations extend a little less than half way from beak to cardinal extremities.

DISCUSSION. As Caster (1939, p. 99, 103) has shown, the genotype of *Strophonella* is a mid-Silurian species with only partly denticulate hinge. *S. prolongata* fully agrees in this respect, but differs from the genotype in having mostly simple instead of highly fasciculate costellae.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. This is not a common form and the writer has found it at only two localities, 4-(9), (44); 23-(21), in a zone 50 to 85 feet above the base of the formation.

Strophonella dixonii Foerste

Plate V, figs. 6, 7

Strophonella dixonii Foerste, 1909B (p. 85, pl. 2, fig. 21).

DISCUSSION. The shell is similar in shape to *S. prolongata* but much smaller, its geniculation occurring between 6 and 7 mm. from the beak of the dorsal valve. It is also somewhat more alate than that species, the hinge line being almost 3 times the length of the shell. It differs further in surface ornamentation since its costellae subdivide frequently and appear fasciculate and much finer and more numerous than in *S. prolongata*. Near the front margin 14 or 15 costellae occupy a space of 5 mm. The interior of this form has not been seen, but the cardinal margin shows it to be denticulate for approximately one-third the distance from beak to cardinal extremities.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. Only one specimen of this species has been collected from locality 18-(2). Foerste had collections from a glade southwest of Dixon Springs and from Clifton, Tennessee.

Strophonella roemerii Foerste

Strophonella roemerii Foerste, 1903 (p. 711; 1909B, p. 84, pl. 2, fig. 24).

DESCRIPTION. The shell is subtrigonal in outline, slightly wider than it is long. It is thin, resupinate and geniculate. The dorsal valve is flat to slightly concave for a distance of 18 to 20 mm. anterior to the beak and is then deflected downward at an angle of 50 to 60 degrees. The length of this deflected portion is about equal to that of the visceral disc. The costellae are of two ranks, the larger of these being low, rounded and rather widely spaced, and tending to increase in size and spacing toward the outer margins where there are 9 to 10 in a distance of 10 mm. Three or four narrow, faint costellae occupy the space between the larger costellae.

One incomplete ventral valve in the collection shows the cardinal margin to be denticulate for a distance of 8 or 9 mm. on each side of the delthyrium. The inner surface of this valve is granulose, the granules being arranged in radiating rows which parallel the external ornamentation. These granules are large and conspicuous in the area surrounding the muscle scars but become progressively fainter towards the anterior and lateral margins. The muscle scars are only poorly shown but appear to be large and semilabellate and separated in the middle by a low median septum.

DISCUSSION. Only a few incomplete specimens of this species were collected; these agree quite well with Foerste's description and illustration.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. Collections from the following localities and horizons: 4-(32); 18-(2), (13); 33-(100); 43-(94). Collected 23 to 60 feet above the base of the formation.

Strophonella laxiplicata? Foerste

Strophonella laxiplicata Foerste, 1903 (p. 711; 1909B, p. 86, pl. 2, fig. 25).

DESCRIPTION. A few fragmentary specimens were collected which are provisionally referred to this species. These are subtriangular to subcircular in outline with the width about equal to the length. The valves are rather flat in the posterior portion, becoming gently deflected at a distance of about 12 mm. in front of the beaks. The costellae are relatively coarse and increase in number towards the margins by intercalations. The interspaces are wide and there appear to be no intermediate, fine costellae. None of the specimens show the fine concentric striae which Foerste mentions in his description of this species. The largest specimen is about 30 mm. wide at the hinge line.

DISCUSSION. This species apparently differs from *S. roemerii* in its smaller size and in the nature of the costellae which in *S. laxiplicata* are all of one size.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. Specimens from localities 13-(41); 24-(12); 29-(77); 39-(118).

Genus *Brachyprion* Shaler, 1865

Brachyprion? *glabella* Amsden, n. sp.

Plate V, figs. 1-5

DESCRIPTION. The shell is small, subtriangular in outline and strongly concavo-convex. Its surface is smooth but the shell is not nacreous. In lateral profile the

ventral valve is arched with even curvature so that the greatest height is at the mid-length; the lateral slopes are somewhat less arcuate. The dorsal valve follows closely the curvature of the ventral. Each valve has a narrow cardinal area, that of the ventral valve lying approximately in the plane of the valve margin and the dorsal standing out almost at right angles thereto. The hinge line is denticulate for approximately half the distance from beak to cardinal extremity. Three specimens of this species were collected; two of these are about equal in size, measuring 9 mm. wide, 7 mm. long and 3 mm. deep; the third is perhaps 1 mm. wider. None of the specimens show the internal character.

DISCUSSION. This shell probably represents a new genus and is only referred to *Brachyprion* as a matter of convenience until the internal characters can be studied. The smooth surface gives it a superficial resemblance to the Devonian genus *Pholidostrophia* that is belied by its non-nacreous shell structure. It resembles *Brachyprion* in its size and curvature and in its partly denticulate hinge, but the genotype, *Brachyprion leda* (Billings, 1860, p. 55, figs. 2-3), has a finely costellate surface. Furthermore Caster (1939, pp. 31, 33) has proposed to restrict this genus to those forms with only a few denticles located on an expanded plate on either side of the delthyrium.

This species along with *Pholidostrophia lindenensis* (Dunbar, 1920, p. 126, pl. 2, figs. 15-16) and an undescribed species in the Waldron shale appears to form a natural group, but since it has been impossible to study the interiors of either valve in any of these species it is thought unwise to propose a new genus.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. There are 3 specimens of this species in our collections from localities 4-(9); 18-(2).

Genus *Fardenia* Lamont, 1935

Fardenia roemeri (Foerste)

Plate V, figs. 23-28

Orithothes roemeri Foerste, 1903 (p. 711).

Schuchertella roemeri Foerste, (1909B, p. 82, pl. 2, fig. 27A-C).

Strophomena pecten Roemer, 1860 (p. 67, pl. 5, fig. 4; non Linnaeus 1767).

DESCRIPTION. Shell subelliptical to slightly subquadrate in outline, hinge somewhat extended. Lateral profile gently biconvex with the ventral valve having slightly greater convexity; ventral valve with maximum convexity at the umbo, becoming flatter towards the anterior and lateral margins. Dorsal valve rather flat in the umbonal region, becoming gently convex towards the anterior and lateral margins. A faint, shallow sulcus begins just before the dorsal beak, becoming broad and ill defined towards the front. Surface covered with narrow, acute costellae separated by somewhat wider and rounded interspaces and crossed by fine concentric lirae. Costellae increasing by intercalations but becoming somewhat coarser towards margins where 8 or 9 occupy a space of 5 mm. The largest specimen in this collection measures 30 mm. wide, 16 mm. long.

Ventral valve with short but well developed dental plates; delthyrium open except for a small, flat, pedicle callist in the apical end (pl. V, fig. 26). Cardinal area of ventral valve slightly wider than dorsal; that of both valves longitudinally striated. Cardinal process bilobed at posterior end, anterior end extending as two diverging elevated plates (pl. 5, figs. 27-28); large, arched hoodlike plate completely enclosing the cardinal process at the posterior end. Growth lines from cardinal area extend across this plate.

DISCUSSION. Roemer called this species *Strophomena pecten* after the Linnean species *Anomia pecten* although he noted that the American species was smaller and the costellae coarser. He also thought that *Strophomena subplana* (Conrad) was a synonym. Foerste, however, believed the Brownsport form to be distinct from *S. pecten* and also noted several differences between it and *S. subplana*. He proposed *roemeri* for this species, first referring it to the genus *Orthothes* and later changing it to *Schuchertella*. Bassler (1915, p. 1150) erroneously credited the species *pecten* to Roemer and thought that the specimens studied by Roemer and Foerste constituted two distinct species. The writer believes Foerste was correct in thinking that the two were identical.

The specimens collected agree in outline, size and ornamentation with those figured by Roemer and Foerste. Roemer's figure of the lateral profile (1860, pl. 5, fig. 4b) shows a reversal of curvature which is probably due to crushing of the specimen. The shell wall of this species is thin and commonly shows distortion. Neither Roemer nor Foerste mentions the dorsal sulcus, but this is not conspicuous and is only displayed in well preserved specimens.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. Not a common species; collections from the following localities: 4-(14), (44); 18-(2), (13); 25-(4); 33-(100); 40-(123); 49-(109). Found throughout most of the formation.

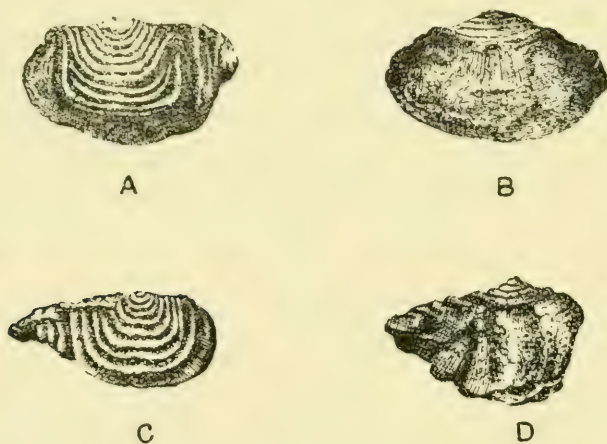


Figure 26. *Leptaena rhomboidalis* after Wilckens (1769, pl. 8, figs. xliiiA, B; xliiA, B).

A and B, ventral and anterior views of the same specimen (Wilckens, figs. xliiiA, B); C and D, ventral anterior views of another specimen (Wilckens, figs. xliiA, B).

Genus *Leptaena* Dalman, 1828

Leptaena tennesseensis Amsden, n. sp.

Plate V, figs. 16-22

DESCRIPTION. Shell fully twice as wide as long with cardinal extremities extending into "ears." Visceral disc of ventral valve gently convex to nearly flat, bearing 10 to 15 subconcentric rugae; rugae on the beak small and indistinct, becoming

progressively larger toward the outer margins; last one forms an abrupt geniculation separating visceral disc from trail. Shells showing considerable variation in size and course of rugae, the number ranging from 8 to 10 on each valve. Entire surface marked by fine, even, rounded costellae, separated by narrow interspaces. An average specimen measures about 32 mm. wide at hinge line, visceral disc 15 mm. long, trail 7 mm.

Ventral and dorsal interiors as shown on plate V, figures 20, 21. Cardinal area of ventral valve about twice as wide as dorsal (pl. V, fig. 22). Delthyrium closed by small deltidial plates.

DISCUSSION. *Leptaena tennesseensis* differs from *L. rhomboidalis* (Wilckens 1769, p. 78, pl. 8, figs. 43, 44; see text fig. 26 for a reproduction of Wilckens figures) in several respects. In *L. rhomboidalis* the visceral disc is about equal in length to the trail whereas in *L. tennesseensis* it is about twice as long as the trail. *L. rhomboidalis* is subquadrate in outline, this being especially noticeable if the outline of the rugae is considered. The outline of the shell and of the rugae in the Brownsport species is more rounded, approaching a subelliptical shape.

L. richmondensis (Foerste, 1909B, p. 211, pl. 4, fig. 11) does not have as prominent rugae as does *L. tennesseensis* and the hinge line is not as extended.

This is probably the species which Roemer identified as *Strophomena depressa* (1860, p. 65, pl. V, fig. 2).

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. Common and widely distributed, found throughout most of the formation. Collections from the following localities and horizons: 4-(1), (9), (14), (29), (44); 7-(11); 9-(3); 13-(49); 18-(2), (13); 19-(19); 25-(4); 30-(78); 33-(100); 39-(73); (103); 40-(136).

Leptaena delicata Amsden, n. sp.

Plate V, figs. 11-15

DESCRIPTION. Shell small and delicate; subquadrate in outline with hinge line extended to form sharp points. Lateral profile concavo-convex; ventral valve almost flat for approximately 5 mm. in front of beak, then deflected abruptly down; deflected portion about 3 mm. deep; dorsal valve closely follows the ventral; in anterior portion of dorsal disc there is a deep, concentric depression (pl. V, fig. 13). Visceral disc of each valve bearing 6 to 8 subconcentric rugae, those near the beak being small and obscure, the rest becoming progressively stronger. Entire surface covered with low, rounded and closely spaced costellae. The largest specimen in the collections is 14 mm. wide, 7 mm. long to geniculation and its trail is about 4 mm. long.

Dorsal interior as shown on plate V, fig. 15; no well preserved ventral interiors were observed.

DISCUSSION. *Leptaena incrassata* (Hall, 1847, p. 19, pl. 4 bis, figs. 2a-c) has a more rounded outline and lacks the concentric corrugations of *L. delicata*.

Leptaena sinuosa (Kindle, 1915, p. 13, pl. I, figs. 1-4) has much the same shape as *L. delicata* but differs in its larger size and in possessing 8 to 10 widely spaced, sharp costellae with finer costellae between. *L. parvula* (Kindle, *ibid.*, p. 14, pl. I, figs. 5-9) is slightly larger and lacks the subquadrate shape; also it is not as strongly geniculate as *L. delicata*.

The association of *L. delicata* with *L. tennesseensis* suggests that it is an immature specimen of the latter but the well developed trail would seem to be against this idea. Dr. G. A. Cooper has pointed out to the writer that such associations of

large and small specimens, both apparently distinct, is not uncommon among the Leptaenas. For the present it seems best to separate the two as distinct species.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. Common and widespread, collected from a zone ranging 1 to 77 feet above the Dixon-Brownsport contact; found at the following localities: 4-(6), (9), (29), (44); 18-(2), (13); 9-(3); 6-(30); 22-(15); 27-(119); 29-(71); 33-(100); 39-(73); 44-(133); 45-(120).

Order TELOTREMATA

Superfamily RHYNCHONELLACEA

Genus *Camarotoechia* Hall and Clarke, 1892

Camarotoechia perryvillensis Amsden, n. sp.

Plate VI, figs. 1-8

DESCRIPTION. The shape of this species is well shown by figures 1-4, 6, 7 of plate VI. The ventral beak is narrow, acute and erect. A broad shallow sulcus appears at about mid-length of the ventral valve and deepens towards the front; a corresponding fold is present on the dorsal valve. There are commonly 6 or 8 simple, low, subangular plications on the fold and 5 or 7 in the sulcus and 8 to 10 on each lateral slope, but occasionally there is an odd number on the fold and an even number in the sulcus. The outermost plications on the lateral slopes are progressively indistinct. An average adult specimen measures 12 mm. long, 13 mm. wide and 9 mm. thick.

The ventral valve has vertical dental lamellae and a low, median septum that extends about one-third the length of the valve; the muscle field is not deeply impressed (pl. VI, fig. 5). The dorsal valve possesses a divided hinge plate and small cruralium from the front of which a low median septum extends forward almost to the mid-length of the valve.

DISCUSSION. This species is similar in size and outline to *C. winiskensis* (Whitcaves, 1906, p. 272, pl. 25, figs. 5-6) but *C. perryvillensis* has a more sharply defined fold and sulcus. Also it has somewhat coarser ribs and the front margin is more sharply sinuate than in *C. winiskensis*.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. Abundant and widespread, collected throughout the formation. Collections from the following localities and horizons: 4-(1), (9); 9-(3); 18-(2), (13); 24-(12); 25-(4); 28-(74); 29-(72); 30-(83); 32-(101); 33-(100); 49-(109).

Camarotoechia shannonensis Amsden, n. sp.

Plate VI, figs. 9-16

DESCRIPTION. This is a small species with very narrow umbones. The ventral valve has a small, erect beak and a sulcus which begins about mid-length of the valve, becoming deep at the anterior margin; the dorsal valve has a corresponding fold. The surface is covered with subrounded plications of which there are 3 on the sinus and 4 on the fold and 3 or 4 on each lateral slope, decreasing in size towards the lateral margins. The largest specimen in our collection measures 8 mm. long, 8 mm. wide and 5 mm. deep.

The ventral valve has vertical dental lamellae and a poorly defined muscle area. The dorsal interior is shown on plate VI, figure 12.

DISCUSSION. *C. shannonensis* is smaller than *C.?* *indianensis* (Hall, 1863A, p. 215). *C. pisa* (Hall and Whitfield, 1875, p. 135) is a larger form with a less prominent fold and sulcus. *C. shannonensis* lacks the sharp plications of *C. nucula* var. *planorugosa* (McLearn, 1924, p. 69) and also the fold of the latter is more prominent. *C. nucula* var. *moydartensis* (McLearn, 1924, p. 70, figs. 9-11) is a slightly larger and more gibbous form. *C. shannonensis* is a larger form than *C. eccentrica*, n. sp., and has one more plication on the fold and on the sulcus.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. Uncommon; collections from the following localities and horizons: 4-(1); 9-(3); 18-(2); 25-(4); 33-(100); 49-(109); collected from a zone 30 to 60 feet above the base of the formation.

Camarotoechia eccentrica Amsden, n. sp.

Plate VI, figs. 17-25

DESCRIPTION. Shell small, suboval in outline with length about equal to width. Ventral beak rather pointed, erect; sulcus beginning about mid-length of ventral valve, becoming well developed at anterior end; 2 plications in sulcus, one usually larger and occupying a central position, the other smaller and located to one side. Dorsal valve with fold beginning about mid-length, becoming prominent at the front edge; marked by 3 plications, 2 of these about equal in size and occupying a central position, the third smaller and crowded to one side. Lateral slopes with 3 or 4 subrounded plications; plications less prominent in posterior portion but traceable to the beaks. An average individual measures 6-7 mm. long, 6-7 mm. wide, 5-6 mm. thick.

Ventral valve with slender, vertical dental lamellae supporting the teeth; muscle field not deeply impressed; no median septum observed. Dorsal valve with a divided hinge plate supported on a median septum to form a cruralium as shown in plate VI, figure 25.

DISCUSSION. *C. eccentrica* differs from *C.?* *acinus* (Hall, 1863, p. 215) in that the latter is smaller and has only 2 plications on the fold and one in the sulcus. It differs from *C.?* *indianensis* (Hall, 1863B, p. 215) in being much smaller. Foerste (1909B, p. 98) has suggested that *C.?* *acinus* and *C.?* *indianensis* may possess a cardinal process and thus belong to the genus *Stegerhynchus* whereas *C. eccentrica* is without a cardinal process. *C.?* *acinus convexa* (Foerste, 1890, p. 318) and *C.?* *acinus subrhomboidea* (Foerste, 1909A, p. 12) have 2 plications on the fold and one in the sulcus. The former is more convex and has the beak incurved.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. Uncommon; found at the following localities: 18-(2), (13); 25-(4); 33-(100); 49-(109), (131); these collections fall within a zone 30 to 60 feet above the Dixon-Brownsport contact.

Camarotoechia acutiplicata Amsden, n. sp.

Plate VII, figs. 10-14; Text fig. 27

DISCUSSION. The shape of this species is well shown in plate VII, figs. 10-14. Ventral beak small, erect, pedicle foramen mesothyrid; sulcus begins about 5 mm. from the beak, becoming deep at anterior end and bearing 3 plications. Dorsal valve with a fold beginning 3 or 4 mm. in front of the beak, becoming high at front edge and bearing 4 plications. Plications are high and sharply angular; 5 or 6 on each lateral slope. Specimen of average size measures 10 mm. long, 14 mm.

wide, 10 mm. deep. The largest specimen measures 10 mm. long, 14 mm. wide, 10 mm. deep.

Ventral interior with vertical dental lamellae and a low median septum (text fig. 27). Dorsal interior with a cruralium supported on a low median septum as shown in plate VII, figure 14; text figure 27.

DISCUSSION. This species is larger than *C. ekwanensis* (Whiteaves, 1904, p. 42; 1906, p. 252, pl. 25, figs. 4, 4a, 4b) and has 2 or more ribs on each of the lateral slopes. In addition *C. ekwanensis* has its length about equal to its width while *C. acutiplicata* is wider than long. *C. litchfieldensis* (Schuchert, 1903, p. 167, figs.) is a much larger species.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. This is

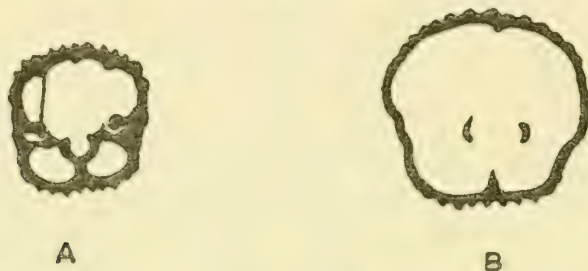


Figure 27. Sections of two different specimens of *Camarotoechia acutiplicata* (ventral valve uppermost).

A. Approximately 1.5 mm. from beak (x 4). Locality 18-(2). Y.P.M. 17548.

B. About 2.5 mm. from beak (x 4). Locality 18-(2). Y.P.M. 17548.

a common and rather widely distributed species which has been collected throughout the lower 75 feet of the Brownsport; collections from the following localities and horizons: 4-(1), (6), (9), (14), (44); 9-(3); 18-(2), (13); 24-(12); 25-(4); 33-(100), (122); 40-(104), (136).

Camarotoechia cedarensis Amsden, n. sp.

Plate VII, figs. 1-9

Rhynchonella tennesseensis Roemer, 1860 pars (figs. 14a, 14c; non-figs. 14b, 14d).

DESCRIPTION. This shell is subtriangular in outline with the width greater than the length. The lateral profile is biconvex; in young shells the dorsal valve is gently convex but it becomes strongly convex at maturity. The ventral beak is pointed and erect and the pedicle foramen is located at the apex. The ventral valve bears a low fold which dies out at about 7 mm. from the apex and is replaced by a shallow sulcus that is not sharply defined except near the front of the shell. On the dorsal valve the umbo bears a complementary sulcus which shortly dies out and is replaced by a broad fold. The surface normally bears 14 simple, subangular plications on the dorsal valve and 15 on the ventral valve; of these 5 are in the sulcus and 6 on the fold. In some shells one or two additional pairs of incipient plications appear at the lateral margins. In addition the surface bears fine but sharp, evenly-shaped, concentric lirae separated by broader, rounded

interspaces (pl. VII, fig. 8). A specimen of average size measures 14 mm. long, 18 mm. wide and 11 mm. thick.

The ventral interior (pl. VII, fig. 7) of this species is quite similar to that in *C. eccentrica*, *C. shannonensis*, *C. perryvillensis* and *C. acutiplicata*. No median septum has been observed in this valve. The dorsal valve differs slightly; the median septum is rather low, becoming thickened at the posterior end to form a platform which abuts against the base of the divided hinge plate, thus making a small and poorly defined cruralium. Cardinal process is absent.

DISCUSSION. Externally this species differs from *Trigonirhynchia tennesseensis* (Roemer, 1860, p. 72, emend Amsden) in that the beak is erect while in the latter the beak is curved over the dorsal valve. Also the anterior commissure is different, for in *C. cedarensis* the sulcus is not sharply deflected and its side is subparallel while in *T. tennesseensis* it is more tongue-shaped. The latter species lacks the fine, evenly-spaced, concentric lirae. The internal structures of these two are quite different. (See Discussion under *T. tennesseensis*.)

Roemer's figures of *Rhynchonella tennesseensis* include specimens of both *Trigonirhynchia tennesseensis* and *C. cedarensis*. His two anterior views (figs. 14c, 14d) are very different, figure 14c comparing closely to the anterior view of *C. cedarensis* (pl. VII, fig. 4) while 14d seems to be identical with *T. tennesseensis* (pl. VII, fig. 18). Also his dorsal view in figure 14a is similar to the dorsal view of *C. cedarensis* shown in plate VII., figure 1. Roemer's figures all show the fine, evenly-spaced concentric lirae but this must be an error since only *C. cedarensis* possesses them to any marked extent.

This species is rather similar to *C.?* *antiqua* (Savage, 1913, p. 82, pl. 5, fig. 3) but differs in that the latter has the length about equal to the width while *C. cedarensis* is considerably wider than long. Also in *C.?* *antiqua* the beak is tightly incurved while in the Brownsport form it is not.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. This species is very common at localities 4-(1), (6) and 18-(2), (13), where it is found in a zone 38 to 50 feet above the base of the Brownsport. A few specimens have also been found at 25-(4); 33-(100), (122); 49-(109); 40-(136).

Genus *Trigonirhynchia* Cooper, 1931

Trigonirhynchia tennesseensis (Roemer), emend Amsden

Plate VII, figs. 15-25

Rhynchonella tennesseensis Roemer, 1860 pars (p. 72, pl. 5, figs. 14B?, 14d; non 12a, 14c).

Unicrinulus tennesseensis pars (Bassler, 1915, p. 1312).

Trigonirhynchia tennesseensis (Cooper in Shimer and Shrock, 1944, p. 313, pl. 120, figs. 8, 9).

DESCRIPTION. Externally this species is quite similar to *Camartoechia cedarensis*. It differs in the nature of the beak which is incurved over the dorsal valve and in the anterior commissure (compare pl. VII, fig. 4 with pl. VII, fig. 18). The pedicle foramen of *C. cedarensis* is mesothyrid while in *T. tennesseensis* it is permesothyrid. Also *T. tennesseensis* lacks the evenly-spaced, concentric lirae.

There is a small fold on the ventral beak which extends for approximately 4 or 5 mm. and is then replaced by a prominent sulcus. At the posterior end of the dorsal valve there is a corresponding shallow sulcus which extends forward 4 or 5 mm. and is then replaced by a prominent fold. The surface is covered with sub-angular plications, about 16 or 17 on each valve.

The internal structure of this species is quite different from that of *C. cedarensis*.

The ventral teeth are stout and attached to the wall of the valve; the dental plates are rudimentary and free for only a short distance at their anterior end. The diductor scars are elongate, oval, and rather deeply impressed, extending for approximately half the length of the valve; the two scars are separated by a low ridge (pl. VII, fig. 22); the diductor scars are small, subcircular in outline, and completely surrounded by the adductors. Small deltidial plates close the posterior part of the delthyrium except for the small permesothyrid pedicle foramen (pl. VII, fig. 25).

In the dorsal valve the hinge plate is divided (pl. VII, figs. 21, 24); between these plates the shell is thickened into a tiny platform and from the front edge of this elevation a low, obtuse median septum runs forward. The cardinal process is as shown on plate VII, figures 21, 23, 24; it is rather massive and is directed beyond the beak of the valve. Crura attached to the base of the cardinal process. Dental sockets rather deep. Dorsal muscle scars not observed.

DISCUSSION. Muir-Wood (1925, pp. 92-95) states that the genotype of *Trigonirhynchia* (*T. fallaciosa*) lacks a cardinal process. *T. tennesseensis* differs in that it has a cardinal process but is similar in other internal structures.

As noted in our discussion of *C. cedarensis* it is evident that Roemer included specimens of both *C. cedarensis* and *T. tennesseensis* in his description and illustrations of *Rhynchonella tennesseensis*. It is proposed here to exclude those forms like *C. cedarensis*.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. This species is quite common and widespread and found throughout the formation. It is very often associated with *C. cedarensis* with which it has been confused. Collections from the following localities: 4-(1), (14); 9-(3); 7-(11); 13-(49); 18-(2), (13); 15-(47); 25-(4); 27-(75); 28-(74); 30-(78); 32-(115); 33-(122), (100); 39-(121); 49-(109).

Bassler states (1915, p. 1312) that Roemer's species *Uncinulus tennesseensis* (here considered to include two species, *Trigonirhynchia tennesseensis*, and *Camarotoechia cedarensis*) also occurs in the Louisville formation, Kentucky, and at Yellow Springs, Ohio.

Genus *Wilsonella* Nikiforova, 1937

(Equals *Wilsonia* Kayser, 1871; non Bonaparte, 1838)

Wilsonella saffordi (Hall)

Plate VIII, figs. 19-25

Rhynchonella wilsoni Roemer, 1860 (p. 71, pl. 5, figs. 13a, b; non Sowerby, 1818).

Rhynchonella saffordi Hall (1860, p. 146).

Wilsonia saffordi (Hall and Clarke, 1893, p. 193, pl. 58, figs. 5-14).

Uncinulus saffordi (Cooper in Shimer and Shrock, 1944, p. 313).

DESCRIPTION. Shell subcuboidal; ventral valve weakly convex, dorsal valve strongly so. Shells commonly wider than long; height of the two valves commonly exceeds width at maturity; anterior end strongly flattened. Ventral beak small, closely incurved over the dorsal; sulcus shallow but distinct, beginning 6 to 7 mm. from the beak and bearing 5, rarely 6, low, rounded costellae. Dorsal valve with a low but distinct fold, usually bearing 6 costellae. Lateral slopes with 11 to 14 low, rounded costellae. Costellae indistinct around the beaks; at the anterior end they are flattened and marked by a sharp, narrow, median groove.

Ventral interior with rather deeply impressed muscle scars separated by a ridge; dental plates lacking (pl. VIII, fig. 24); pedicle foramen mesothyrid. Dorsal hinge plate divided; median septum low; cardinal process lacking (pl. VIII, fig. 25).

DISCUSSION. Cooper has referred this species to *Uncinulus* (Bayle, 1878, pl. 11; Oehlert, 1884, p. 422; Muir-Wood, 1925, pp. 92-95), but that genus possesses a cardinal process, a feature which is lacking in the Brownsport specimens.

Roemer identified this species as *Rhynchonella wilsoni* (*W. wilsoni*). The Brownsport species, however, differ from *W. wilsoni* in that the height of the two valves does not exceed the width as much as Sowerby's figures would indicate. Furthermore in *W. saffordi* the sulcus in the ventral valve is clearly depressed below the general level of the shell while Sowerby's figures and description indicate that such is not the case in *W. wilsoni*. Hall noted this difference when giving his original description and Roemer's figures also show the sulcus as clearly depressed.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. Bassler also cites the following localities: "Louisville, Kentucky (Louisville); Georgetown and Bunker Hill, Indiana." It is abundant and widespread in the Brownsport and has been found throughout the formation. Collections from the following localities and horizons: 2-(135); 4-(1), (9); 18-(2), (13); 9-(3), (18); 19-(16), (19); 24-(12); 25-(4); 26-(79), (81); 29-(71); 33-(100), (122); 36-(137); 39-(73); 40-(123), (136); 44-(133); 49-(109), (131); 51-(69).

Wilsonella? *compressa* Amsden, n. sp.

Plate VIII, figs. 14-18

DISCUSSION. Shell suboval in outline, wider than long. Lateral profile biconvex, dorsal valve with slightly greater convexity. Ventral beak small, incurved over the dorsal; sulcus beginning 5 to 6 mm. in front of the beak, becoming well defined but not deep in anterior portion. Dorsal valve with a low fold, marked only in anterior third of the valve. Surface of each valve bearing 23 to 24 low, rounded costellae of which there are about 6 on the fold and 5 on the sulcus and 8 or 9 on each lateral slope. Costellae become obsolete toward the beak; in anterior portion of the ventral valve they are flattened for a short distance and bear a median groove. Average specimen measures 11 mm. long, 13 mm. wide and 6 mm. thick. No interiors have been seen.

DISCUSSION. The reference of this species to *Wilsonella* is provisional since no interiors have been studied. *W.?* *compressa* differs from *W. saffordi* in that the dorsal valve is much less gibbous and the umbo much less curved. Furthermore the ventral beak is not as strongly hooked and the umbonal region is flatter than in *W. saffordi*.

Wilsonella(?) *saffordi* var. *depressa* (Nettleroth, 1889, p. 80, pl. 33, figs. 1-3) is much more triangular in outline and has an erect beak.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. Rare; found only at localities 18-(2); 27-(87); 33-(100).

Wilsonella? sp.

Plate VIII, figs. 9-13

DISCUSSION. There is a single well preserved specimen in the collections which is similar in outline to *Wilsonella saffordi* but differs in being a smaller, much less gibbous form with more numerous, closely spaced costellae. There are 27 to 28 costellae on each valve of which about 8 are located on the fold and 8 on the

sulcus. These costellae disappear towards the posterior end of the shell; at the anterior end they are flattened and bear a median groove.

The reference of this specimen to *Wilsonella* is provisional since no interiors of either valve have been seen. It does not seem advisable to establish a new species upon this single individual.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee; one specimen found at locality 4-(14).

Genus *Dictyonella* Hall, 1867

Dictyonella gibbosa (Hall)

Plate VIII, figs. 1-8

Eichwaldia gibbosa Hall 1867 (p. 268; Hall and Clarke, 1893, pl. 83, figs. 6, 7).

Dictyonella gibbosa (Schuchert, 1897, p. 211).

DESCRIPTION. Shell subtriangular in outline; lateral profile biconvex, dorsal valve with slightly greater convexity. Ventral beak strongly incurved over the dorsal; broad, shallow, nearly flat sulcus beginning anterior to the umbonal region and not increasing in width as rapidly as does the valve. Dorsal valve with low fold, not as well defined as ventral sulcus. Exterior punctuate, with the punctae arranged in quincunx; punctae defined by a series of ridges which give the surface a reticulate appearance as shown in plate VIII, figures 2-3, 7-8. The largest specimen in our collection measures 13 mm. long, 14 mm. wide and 7 mm. long.

The pedicle foramen is epithyrid. No interiors seen.

DISCUSSION. There are only 4 individuals of this species in the collections. The small specimen shown in plate VIII, figures 6-8, is probably an immature individual. In addition the collections contain two incomplete specimens which appear to have more closely spaced reticulations and a much less sharply defined fold and sulcus. These are probably specimens of *D. concinna* (Hall, 1867, p. 278; Hall and Clarke, 1893, p. 183, fig. 5).

The taxonomic position of this species is uncertain.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. Collections from localities 18-(2) and 19-(16); from a zone 30 to 50 feet above the base of the formation.

Order TELOTREMATA

Superfamily ATRYPACEA

Genus *Atrypa* Dalman, 1828

Atrypa tennesseensis Amsden, n. sp.

Plate IX, figs. 1-9

DESCRIPTION. Shell subcircular in outline; hinge line less than greatest width. Lateral profile biconvex; ventral valve weakly convex, dorsal valve strongly convex. Ventral beak small, closely incurved over the dorsal valve; ventral sulcus shallow, poorly defined, present only in the anterior half of the shell. Dorsal valve gibbous, without a distinct fold. Surface bears low, rounded costellae separated by broadly rounded interspaces; 5-6 costellae in a distance of 5 mm.; costellae crossed by fine, closely-spaced, concentric lirae and growth lamellae; growth lamellae irregularly spaced, tending to be concentrated on anterior part of shell.

Shell substance conspicuously fibrous. A specimen of average size measures 18 mm. long, 17 mm. wide, 11 mm. thick. One of the largest specimens measures 23 mm. wide, 22 mm. long and 12 mm. thick (pl. IX, fig. 6).

In the ventral valve the teeth rest on the lateral wall of the valve and the muscle scars are flabellate (pl. IX, fig. 7). The pedicle foramen is small, round and mesothyrid. The dorsal interior is shown on plate IX, figure 9 and the spiralia and jugum on plate IX, figure 8. In a normal adult shell 17 mm. long each cone of the spiralia consists of 6 or 7 volutions.

DISCUSSION. Linnaeus's (1767, p. 1152) description of *Atrypa reticularis* is not of sufficient detail to make a comparison with this species. *A. tennesseensis* differs from *A. reticularis newsomensis* (Foerste 1903, p. 710; 1909B, p. 93, pl. I, figs. 11A, B) in that the latter is considerably larger and has a better developed ventral sulcus. In *A. nodostriata* (Hall, 1852, p. 272, pl. 56, fig. 2) the two valves are about equal in convexity and the concentric growth lines are much more strongly developed than in *A. tennesseensis*. *A. laticorrugata* (Foerste, 1895, p. 591, pl. 57A, fig. 16) lacks a ventral sulcus and has the two valves about equal in convexity. *A. reticularis hillsboroensis* (Foerste, 1919, p. 381, pl. 17, figs. 1A-D) has a pronounced fold and sulcus. *A. arctostriata* (Foerste, 1903, p. 710) has finer, more numerous costellae and is a smaller species.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. Very abundant and widespread, found throughout the formation; collections from the following localities and horizons: 2-(135); 4-(6), (9), (14), (29), (32), (44); 7-(11); 9-(3); 11-(36); 15-(47); 18-(2), (13); 19-(16), (19), (52); 21-(25); 23-(64); 24-(12); 25-(4); 27-(119); 28-(74); 29-(77); 30-(78), (83); 31-(96); 32-(101); 33-(100), (122); 36-(105); 38-(90); 39-(73), (91), (103), (121), (129); 40-(136), (123); 42-(93); 43-(91); 44-(133); 47-(85); 48-(108), (112); 49-(109), (131); 50-(70).

Atrypa arctostriata Foerste

Plate IX, figs. 10-15

Atrypa arctostriata Foerste 1903 (p. 710; 1909B, p. 93, pl. 2, figs. 34A, B).

DESCRIPTION. Shell subcircular in outline. Lateral profile biconvex, convexity of two valves about equal. Ventral beak small, incurved over the dorsal; small, rounded, mesothyrid pedicle foramen. Surface bearing fine, closely-spaced rounded costellae separated by narrow, rounded interspaces; about 15 costellae occupy a space of 5 mm. Growth lamellae long and imbricating, especially on anterior half of the shell. An average specimen measures 16 mm. wide, 15 mm. long, 7 mm. thick. No interiors were seen.

DISCUSSION. *A. arctostriata* differs from *A. tennesseensis* in its smaller size, finer costellae, long growth lamellae, and less gibbous dorsal valve.

The shell of this species is quite thin and most of the specimens in the collection show some crushing.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. This is not a common species and has been found only at localities 4-(1), (9), (44); 18-(2); 22-(15).

Genus *Plectatrypa* Schuchert and Cooper, 1930*Plectatrypa brownsportensis* Amsden, n. sp.

Plate XXXIV, figs. 2, 3, 8-10

Atrypa marginalis Roemer, 1860 (p. 69, pl. 5, figs. 10a, 10b; non Dalman, 1828, p. 59, pl. 6, fig. 6).

DESCRIPTION. Shell subcircular in outline with hinge line less than greatest width. Lateral profile biconvex, dorsal valve with slightly greater convexity. Ventral beak slightly incurved; ventral valve with a sulcus beginning about two-thirds of the distance from beak to border, becoming pronounced at the anterior end; sulcus usually bearing 2 or 3 costellae. Dorsal valve with a fold beginning at about mid-length and becoming prominent at the anterior end; fold marked by 2 or 3 costellae. Surface multicostellate with the costellae in the posterior half of the valve broad and rounded, tending to split into two near the anterior margin. About 25 ribs on the anterior margin of a mature shell. A specimen of average size measures 13 mm. wide, 12 mm. long and 7 mm. thick.

DISCUSSION. This species most closely resembles *Plectatrypa praemarginalis* (Savage, 1917, p. 129, pl. 6, figs. 14-16; Cooper in Shimer and Shrock, 1944, p. 317, pl. 120, figs. 66-68) but differs in having lower, broader and more rounded ribs. The ribs of the Brownsport species also appear to be less fasciculate.

There are a considerable number of specimens in the collections but many of them appear to have been crushed.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. Specimens from the following localities: 2-(38), (135); 39-(73), (103), (121).

Genus *Lissatrypa* Twenhofel, 1914*Lissatrypa decaturensis* Amsden, n. sp.

Plate IX, figs. 16-23

DESCRIPTION. Shell subcircular in outline. Lateral profile biconvex, convexity of two valves about equal. Ventral beak incurved over the dorsal but not in conjunction with it; pedicle foramen small, rounded, mesothyrid. Some dorsal valves have a faint, longitudinal depression. Surface bearing rather conspicuous, concentric ornamentation consisting of unevenly-spaced, sublamellose varices; no other ornamentation. Shell substance fibrous. A specimen of average size measures 7 mm. long, 8 mm. wide, 4 mm. thick; largest specimen in the collections measures 9 mm. long, 10 mm. wide, 4 mm. thick.

In the ventral valve the teeth rest directly on the lateral slopes of the valve and the muscle scars are deeply impressed as shown in figure 23 of plate IX. As shown in figure 21 of plate IX the spiralia have the atrypoid form with a well developed jugum and dorsally directed spires, each of which consists of about 3 volutions and is fringed with numerous, needle-like spines. The dorsal interior is shown in figure 22 of plate IX.

DISCUSSION. Externally *L. decaturensis* is similar to *Nucleospira concentrica* (Hall, 1859, p. 223, pl. 28B, figs. 15-19), but differs in the lack of spines. Internally it differs in the position of the spire which is dorsally directed in *Lissatrypa* and laterally directed in *Nucleospira*.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. This is a rather common species and has been found throughout the formation; collections

from the following localities and horizons: 7-(11); 9-(3); 18-(2), (13); 24-(12); 25-(4); 28-(74); 30-(83); 33-(100); 40-(136); 49-(109).

Genus *Coelospira* Hall, 1863

Coelospira saffordi (Foerste)

Plate X, figs. 1-5

Anoplothea (*Coelospira*) *saffordi* Foerste, 1903 (p. 709).

Anoplothea saffordi (Foerste, 1909B, p. 89, pl. 1, fig. 6).

Coelospira saffordi (Bassler, 1915, p. 254).

DESCRIPTION. Shell small, circular in outline, Lateral profile concavo-convex; ventral valve strongly convex and bearing a low fold; dorsal valve weakly concave and bearing a shallow sulcus. Ventral beak small, incurved; pedicle foramen small, round, mesothyrid. Surface marked by low, rounded costellae of which initially there are 3 on each lateral slope, 2 on the fold and 1 in the sulcus; those on lateral slopes remain simple but those of fold and sulcus increase to 5 and 4 respectively on the anterior part of the shell. The increase in the number of ribs on the fold takes place in the following manner; a short distance in front of the beak a costella is implanted between the two initial ones; these two initial costellae then bifurcate, thus producing 5 ribs at the anterior end of the valve. In the sulcus the costellae increase by a division of the initial costella to form two, and the implanation of an additional rib on each side, thus producing 4 costellae at the anterior end of the valve.

The largest specimen in our collection measures 5 mm. long, 5 mm. wide and 3 mm. thick.

The ventral teeth rest directly on the wall of the valve and there is a low median septum extending approximately half the length of this valve (pl. X, fig. 5). The spire consists of 2 or 3 loops with their apices directed ventro-laterally. Two processes unite to form a simple jugum which is located in the posterior portion of the shell and is postero-ventrally directed. The muscle scars and articulation of the dorsal valve have not been observed.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. These are only moderately common and have been collected from a zone 30 to 60 feet above the base of the formation. Collections from the following localities: 7-(11); 9-(3); 18-(2), (13); 24-(12); 25-(4); 33-(100); 49-(132).

Superfamily SPIRIFERACEA

Genus *Delthyris* Dalman, 1828

Delthyris saffordi (Hall)

Plate XI, figs. 10-20

Spirifer saffordi Hall, 1859 (p. 203, pl. 28, figs. 2a, b, c, e, f).

Spirifer (*Delthyris*) *saffordi* (Bassler, 1915, p. 1177).

DESCRIPTION. The lateral profile of this shell is biconvex with the ventral valve having slightly greater convexity than the dorsal. The ventral beak is erect except for the posterior tip which is slightly hooked. The ventral cardinal area is divisible into two parts: a central, triangular portion located on each side of the delthyrium and marked by vertical striations, and an outer zone which is marked by horizon-

tal striations (pl. XI, fig. 18). There is a prominent but narrow ventral sulcus and a corresponding dorsal fold. The lateral slopes bear simple rounded ribs separated by rounded interspaces. The ribs are coarsest next to the fold and sulcus and are progressively smaller towards the lateral margins, the fourth pair appearing after the shell is half grown and usually remaining low and obscure. In addition to the ribs the surface is covered with very fine, concentric, evenly-spaced lamellae which bear small spines (pl. XI, fig. 20).

A specimen of average size measures 9 mm. long, 12 mm. wide and 8 mm. thick.

The ventral interior possesses well developed dental plates and a high median septum which extends past the middle of the valve (pl. XI, fig. 14). In old shells the ventral umbo may become thickened by the secondary shell material which extends up the sides of the dental lamellae and almost submerges them. In one such shell (fig. 15 of pl. XI) a plug-like callous almost fills the delthyrial cavity. In some shells there is a thickening in the umbonal region of the dorsal valve as well as the ventral, and the space between the crural bases may be largely filled by a welt of secondary shell growth as in figure 16 of plate XI. A dorsal valve without this callous is shown in figure 17 of plate XI.

DISCUSSION. There are no specimens in the collections which show the character of the spire. The surface ornamentation and the well developed dental plates and ventral septum indicate this species should be referred to the genus *Delthyris*.

DISTRIBUTION. Hall gives the following distribution for this species: "In the shaly limestone of the lower Helderberg group: Becraft's Mountain near Hudson; and Decatur County, Tennessee." Bassler (1915, p. 1177), however, lists only the Brownsport of Decatur County, Tennessee.

Specimens in this collection are from the Brownsport formation at the following localities and horizons: 7-(11); 9-(3), (18); 18-(2), (13); 24-(12); 25-(4); 28-(74); 33-(100); 40-(109), (131). This is a fairly common species and has been collected from the upper 80 feet or so of the formation.

Superfamily ROSTROSPIRACEA

Genus *Merista* Suess, 1851

Merista tennesseensis Hall and Clarke

Plate XI, figs. 1-9

Merista tennesseensis Hall and Clarke, 1894 (pp. 71, 365, pl. 42, figs. 1-6).

DESCRIPTION. This shell is pentagonal in outline and the valves are sub-equally convex. The ventral valve has a narrow, tightly incurved beak that bears a rounded, epithyrid foramen. A shallow sulcus appears near the midlength of this valve and remains narrow and poorly defined to the anterior margin. The corresponding dorsal fold is somewhat broader but equally low. The surface is smooth except for concentric growth lamellae. A specimen of average size measures 16 mm. wide, 16 mm. long and 10 mm. thick. One of the largest specimens in our collection measures 17 mm. long, 18 mm. wide and 12 mm. thick.

In the ventral valve the dental lamellae are high and thin, curving in at the bottom to form a U-shaped trough resting on the median arched structure (pl. XI, fig. 9). The dental lamellae are attached to the side wall of the valve by slender fuleral plates. The central, arched structure extends forward as a hood-like process which has been called the "shoe-lifter" (Hall and Clarke, 1894, p. 70).

The dorsal valve possesses a thin, median septum as shown in figure 7 of plate XI. Figure 8 of this plate shows the spiralia and jugum.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. This is one of the most abundant brachiopod species in the Brownsport. Collections from the following localities and horizons: 4-(1), (6), (9), (14), (44), (32); 7-(11); 9-(3), (18); 18-(2), (13); 19-(16); 24-(12); 25-(4); 33-(100), (122); 40-(136); 48-(112); 49-(131), (109); these collections from a zone ranging from 8 to 73 feet above the base of the formation.

Genus *Homoeospira* Hall and Clarke, 1894

Homoeospira elongata Foerste

Plate X, figs. 16-23

Homoeospira schucherti elongata Foerste, 1909B (p. 89, pl. 1, figs. A, B).

DESCRIPTION. Shell suboval in outline; lateral profile biconvex with valves about equal in convexity. Ventral beak rather strongly incurved over the dorsal valve; ventral sulcus shallow, narrow near the beak becoming slightly broader towards anterior margin; pedicle foramen rounded, mesothyrid; delthyrium closed with deltidial plates (pl. X, fig. 21). Dorsal valve with shallow sulcus which becomes slightly broader at anterior margin. Surface covered with rounded plications of which there are usually 2 in the ventral sulcus and 2 in the dorsal sulcus and 7 or 8 on each lateral slope. A specimen of average size measures 9 mm. long, 7 mm. wide and 6 mm. thick.

The ventral interior is shown in figure 21 of plate X. In the dorsal interior there is a thick median septum and a broad, plate-like cardinal process (pl. X, fig. 23.). Each of the spiralia consists of 3 or 4 coils with their apices directed laterally. The simple jugum is located approximately in the middle of the valve and is inclined towards the ventro-posterior.

DISCUSSION. Foerste (1909B, p. 89) considered this a variety of *H. schucherti* and believed there was a complete gradation between the two forms. The specimens which the writer has examined indicate that these represent two distinct species. *H. schucherti* is a larger species with the ventral beak pointed and erect while in *H. elongata* it is strongly incurved.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. Common, collected from a zone ranging from 8 to 74 feet above the base of the formation. Collections from the following localities and horizons: 4-(1), (6), (9), (14), (44); 9-(3); 18-(2), (13); 24-(12); 25-(4); 33-(100); 49-(109).

Homoeospira schucherti Foerste

Plate X, figs. 6-10

Homoeospira schucherti Foerste, 1903 (p. 709; 1909B, p. 89, pl. 1, figs. 10A, B).

DESCRIPTION. Shell suboval in outline; valves subequally biconvex. Ventral beak pointed, erect; pedicle foramen mesothyrid; ventral sulcus shallow and poorly defined, beginning just in front of the beak and becoming broad but not deep towards anterior margin; usually 2 low costellae in the sulcus. Dorsal valve with a shallow, poorly defined sulcus beginning about 1 mm. in front of the beak and becoming wider but not deep towards anterior margin; usually bearing 2 faint

costellae. Costellae low and rounded, 6 or 7 on each lateral slope. Largest specimen in the collection measures 11 mm. long, 10 mm. wide and 6 mm. thick.

Only one poorly-preserved ventral interior has been seen and this shows the teeth resting on the lateral walls of the valve. The collection also includes one poorly preserved dorsal valve showing a median septum. The character of the spiralia has not been observed.

DISCUSSION. Not much is known of the internal character of this species since Foerste did not discuss it and the present collection does not include any suitable material. The specimens which the writer has seen do indicate that the dorsal and ventral interiors of *H. schucherti* are similar to those of *H. elongata*.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. This is not a common species; there are about a dozen specimens from the following localities: 4-(1), (14); 25-(4); 33-(100); 28-(74).

Homoeospira beecheri Foerste

Plate X, figs. 11-15

Homoeospira beecheri Foerste, 1903 (p. 709; 1909B, p. 90, pl. 1, figs. 8A, B).

DESCRIPTION. Shell suboval in outline; convexity of two valves about equal. Ventral beak only slightly incurved; pedicle foramen rounded, mesothyrid. Ventral sulcus shallow, beginning just in front of beak and becoming broad but not distinct at anterior margin; bearing 2 prominent costellae which are only slightly lower than adjacent ones. Dorsal sulcus shallow, beginning about 1 mm. in front of beak and becoming wider but not deep towards anterior; bearing 2 low, narrow plications. Costellae are high, subrounded and coarse for a shell of this size; 5 or 6 on each lateral slope. Largest specimen in the collection measures 7 mm. long, 7 mm. wide and 4 mm. thick. No interiors have been observed.

DISCUSSION. This species is smaller than either *H. elongata* or *H. schucherti* and has much more prominent costellae. The reference of this species to *Homoeospira* is based upon external similarities since the internal characters have not been studied.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. Rather rare, specimens in this collection from localities 18-(2); 25-(4).

PHYLUM ECHINODERMATA

Class CRINOIDEA

Springer (1926B) has published a comprehensive monograph on the Silurian crinoids (see chapter on Correlation). This publication contains descriptions and illustrations of 76 Brownsport species of which only 13 are represented in the collections now under study. Since Springer's monograph is available to most students the descriptions and illustrations are not repeated here. The following pages give a list of the Brownsport species discussed by Springer with his remarks on geographic and stratigraphic distribution. In those cases where he uses the terms "Beech River, Bob and Lobelville formations" these are quoted verbatim although they are not here regarded as valid divisions of the Brownsport formation. Specimens which are found in the collections studied are noted and their geographic and stratigraphic position is given.

Genus *Dimerocrinites* Phillips, 1839*Dimerocrinites planus* (Springer)

Dimerocrinus planus Springer, 1926B (p. 13, pl. 1, figs. 1-7).

DISTRIBUTION. Springer cites, "Beech River formation, Brownsport group, Niagaran; Decatur County, Tennessee." No specimens in the present collections.

Dimerocrinites milliganae (Miller and Gurley)

Glyptaster milliganae Miller and Gurley, 1896B (p. 87, pl. 5, figs. 7-9).

Dimerocrinus milliganae (Springer, 1926B, p. 13, pl. 1, fig. 8).

DISTRIBUTION. Springer cites the same locality and horizon as *D. planus*. No specimens in the present collections.

Dimerocrinites nodobasis (Springer)

Dimerocrinus nodobasis Springer, 1926B (p. 13, pl. 1, figs. 9, 9a, 10).

DISTRIBUTION. Springer cites same as *D. planus*. No specimens in the present collections.

Genus *Eudimerocrinus* Springer, 1926*Eudimerocrinus multibrachiatus* Springer

Eudimerocrinus multibrachiatus Springer, 1926B (p. 14, pl. 1, figs. 13, 13a,b, 14).

DISTRIBUTION. Springer cites, "Beech River formation, Brownsport group, Niagaran; Decatur County, Tennessee." No specimens in the present collections.

Genus *Gazacrinus* Miller, 1894*Gazacrinus ramifer* (Roemer)

Eucalyptocrinus ramifer Roemer, 1860 (p. 51, pl. 4, figs. 4a, b).

Gazacrinus ramifer (Springer, 1926B, p. 18, pl. 2, figs. 17-21).

DISTRIBUTION. Springer cites, "Beech River formation, Niagaran; Decatur and Wayne Counties, Tennessee." No specimens in the present collections.

Gazacrinus milliganae (Miller and Gurley)

Thysanocrinus milliganae Miller and Gurley, 1896 (p. 51, pl. 3, figs. 23-25).

Gazacrinus milliganae (Springer, 1926B, p. 18, pl. 2, figs. 22-24).

DISTRIBUTION. Springer cites, "Beech River formation, Niagaran; from the glades in Decatur County, Tennessee." No specimens in the present collections.

Genus *Lampterocrinus* Roemer, 1860*Lampterocrinus tennesseensis* Roemer

Lampterocrinus tennesseensis Roemer, 1860 (p. 37, pl. 4, figs. 1a, b).

Lampterocrinus tennesseensis (Springer, 1926B, p. 20, pl. 3, figs. 1-6).

DISTRIBUTION. Springer cites, "Shaly limestone of Beech River formation, Niagaran; Decatur and adjoining counties, Tennessee." There are 5 specimens of this

species in the collections under study from the following localities: 2-(135); 39-(91), (103); 40-(123); collected from the lower 50 to 60 feet of the Brownsport formation.

Lampterocrinus sculptus Springer

Lampterocrinus sculptus Springer, 1926B (p. 21, pl. 3, figs. 7, 8).

DISTRIBUTION. Springer cites the same locality and horizon as *L. tennesseensis*. No specimens in the present collections.

Lampterocrinus roemerii Springer

Lampterocrinus roemerii Springer, 1926B (p. 21, pl. 3, figs. 9-14).

DISTRIBUTION. Springer cites, "soft shale of the Beech River formation, Niagaran; Tuck's Mill, Decatur County, Tennessee." No specimens in the present collections.

Genus *Macrostylocrinus* Hall, 1852

Macrostylocrinus laevis Springer

Macrostylocrinus laevis Springer, 1926B (p. 26, pl. 4, figs. 14-19).

DISTRIBUTION. Springer cites, "Beech River formation, Niagaran; Decatur County, Tennessee." No specimens in the present collections.

(?) *Macrostylocrinus pustulosus* Springer

(?) *Macrostylocrinus pustulosus* Springer, 1926B (p. 26, pl. 4, figs. 25, 25a).

DISTRIBUTION. Springer cites, "Beech River formation, Niagaran; Decatur County, Tennessee." No specimens in the present collections.

Genus *Melocrinites* Goldfuss, 1826

Melocrinites tennesseensis (Springer)

Melocrinus tennesseensis Springer, 1926B (p. 27, pl. 5, fig. 1).

DISTRIBUTION. Springer cites, "Beech River formation, Niagaran; Decatur County, Tennessee." No specimens in the present collections.

Melocrinites oblongus (Wachsmuth and Springer)

Melocrinus oblongus Wachsmuth and Springer, 1897 (p. 200, pl. 22, figs. 9, 12).

Melocrinus oblongus (Springer, 1926B, p. 28, pl. 5, figs. 5, 6).

DISTRIBUTION. Springer cites, "Louisville limestone, Louisville, Kentucky and Bob formation, Niagaran; Decatur County, Tennessee." No specimens in the present collections.

Genus *Cytocrinus* Roemer, 1860

Cytocrinus laevis Roemer

Cytocrinus laevis Roemer, 1860 (p. 46, pl. 4, figs. 2a-c).

Cytocrinus laevis (Springer, 1926B, p. 28, pl. 5, figs. 7, 7a, 8).

DISTRIBUTION. Springer cites, "Beech River formation, Niagaran; Decatur County, Tennessee." There are 4 specimens (without arms) of this species in the

present collections. These came from localities 9-(3) and 39-(103); lower 50 feet of the Brownsport formation.

Genus *Allocrinus* Wachsmuth and Springer, 1890

Allocrinus typus Wachsmuth and Springer

Allocrinus typus Wachsmuth and Springer, 1890 (p. 207, pl. 14, figs. 7-8).

Allocrinus typus (Springer, 1926B, p. 30, pl. 6, figs. 1-4).

DISTRIBUTION. Springer cites, "Beech River formation, Niagaran; Decatur and Wayne Counties, Tennessee." No specimens in the present collections.

Allocrinus ponderosus Springer

Allocrinus ponderosus Springer, 1926B (p. 30, pl. 6, figs. 5, 6).

DISTRIBUTION. Springer cites, "Beech River formation, Niagaran; Decatur County, Tennessee." No specimens in the present collections.

Allocrinus longidactylus Springer

Allocrinus longidactylus Springer, 1926B (p. 30, pl. 6, figs. 7-10).

DISTRIBUTION. Springer cites the same locality and horizon as *A. ponderosus*. No specimens in the present collections.

Genus *Eucalyptocrinites* Goldfuss, 1826

Eucalyptocrinites lindahli (Wachsmuth and Springer)

Eucalyptocrinus lindahli Wachsmuth and Springer, 1892 (p. 139).

Eucalyptocrinus lindahli (Springer, 1926B, p. 36, pl. 8, figs. 4-5).

DISTRIBUTION. Springer cites, "Beech River formation, Niagaran; Wayne and Decatur Counties, Tennessee." No specimens in the present collections.

Eucalyptocrinites milliganae (Miller and Gurley)

Eucalyptocrinus milliganae Miller and Gurley, 1896B (p. 88, pl. 5, figs. 4-6).

Eucalyptocrinus milliganae (Springer, 1926B, p. 37, pl. 8, figs. 6-8).

DISTRIBUTION. Springer cites, "Beech River formation. *Eucalyptocrinus* zone, Niagaran; Tuck's Mill, Decatur County, Tennessee." The present collection has one incomplete dorsal cup which is provisionally referred to this species; locality 9-(3) approximately 50 feet above the base of the Brownsport formation.

Eucalyptocrinites ventricosus (Wachsmuth and Springer)

Eucalyptocrinus ventricosus Wachsmuth and Springer, 1897 (p. 341, pl. 83, figs. 11, 12).

Eucalyptocrinus ventricosus (Springer, 1926B, p. 37, pl. 8, figs. 9-12).

DISTRIBUTION. Springer cites, "Beech River formation, Niagaran; Decatur, Wayne and Perry Counties, Tennessee." The present collection contains 6 dorsal cups belonging to this species. These came from localities: 13-(49); 19-(19); 39-(91), (103), (118), (129); collected through the Brownsport formation.

Genus *Periechocrinites* Austin, 1842*Periechocrinites tennesseensis* (Hall)

Saccocrinus tennesseensis Hall, 1875 (in Hall & Whitfield, p. 125, pl. 6, fig. 10).

Periechocrinus tennesseensis (Springer, 1926B, p. 45, pl. 10, figs. 1-4).

DISTRIBUTION. Springer cites, "Beech River and perhaps other formations of the Brownsport, Niagaran; Decatur, Perry and Wayne Counties, Tennessee." No specimens in the present collections.

Genus *Lyonocrinus* Springer, 1926*Lyonocrinus bacca* (Roemer)

Coccocrinus bacca Roemer, 1860 (p. 51, pl. 4, figs. 5a-c).

Lyonocrinus bacca (Springer, 1926B, p. 51, pl. 11, figs. 6-23).

DISTRIBUTION. Springer cites, "Coccocrinus zone of Beech River formation, Brownsport group, Niagaran; Decatur and Perry Counties Tennessee." The present collection contains two dorsal cups found at localities 4-(6), and 39-(91); lower half of the Brownsport formation.

Genus *Culicocrinus* Muller, 1855(?) *Culicocrinus spinosus* Springer

(?) *Culicocrinus spinosus* Springer, 1926B (p. 51, pl. 11, figs. 4, 4a-c).

DISTRIBUTION. Springer cites, "Beech River formation, Brownsport group, Niagaran; Decatur County, Tennessee." No specimens in the present collections.

Genus *Hapalocrinus* Jaekel emend. Bather, 1897*Hapalocrinus gracilis* Springer

Hapalocrinus gracilis Springer, 1926B (p. 52, pl. 11, figs. 30, 31, 32).

DISTRIBUTION. Springer cites, "Beech River formation, Brownsport group, Niagaran; Decatur County, Tennessee." No specimens in the present collections.

Hapalocrinus cirrifer Springer

Hapalocrinus cirrifer Springer, 1926B (p. 52, pl. 12, figs. 1-4).

DISTRIBUTION. Springer cites, "Beech River formation, Brownsport group, Niagaran; Decatur County, Tennessee." No specimens in the present collections.

Hapalocrinus pinnulatus Springer

Hapalocrinus pinnulatus Springer, 1926B (p. 52, pl. 12, fig. 5).

DISTRIBUTION. Springer cites, "Beech River formation, Brownsport group, Niagaran; Decatur County, Tennessee." No specimens in the present collections.

Hapalocrinus tuberculatus Springer

Hapalocrinus tuberculatus Springer, 1926B (p. 53, pl. 12, fig. 6).

DISTRIBUTION. Springer cites, "Beech River formation, Brownsport group, Niagaran; Decatur County, Tennessee." No specimens in the present collections.

Hapalocrinus tennesseensis Springer

Hapalocrinus tennesseensis Springer 1926B (p. 53, pl. 12, fig. 7).

DISTRIBUTION. Springer cites, "Beech River formation, Brownsport group, Niagaran; Decatur County, Tennessee." No specimens in the present collections.

Genus *Nyctocrinus* Springer, 1926*Nyctocrinus magnitubus* Springer

Nyctocrinus magnitubus Springer, 1926B (p. 54, pl. 12, figs. 16-21).

DISTRIBUTION. Springer cites, "Beech River formation, Brownsport group, Niagaran; Decatur County, Tennessee." No specimens in the present collections.

Genus *Marsupiocrinus* Morris, 1843*Marsupiocrinus rosaeformis* (Troost)

Cupellaecrinites rosaeformis Troost, 1849 (p. 419, nom. nud.).

Marsupiocrinus rosaeformis (Springer, 1926B, p. 57, pl. 13, figs. 1-8; pl. 15, figs. 9, 9a).

DISTRIBUTION. Springer cites, "chiefly *Eucalyptocrinus* zone of the Beech River formation, Brownsport group, Niagaran; Tuck's Mill, near Decaturville, Decatur County, Tennessee." No specimens in the present collections.

Marsupiocrinus tennesseensis (Roemer)

Platycrinus tennesseensis Roemer, 1860 (p. 35, pl. 3, figs. 4a-f).

Marsupiocrinus tennesseensis (Springer, 1926B, p. 57, pl. 14, figs. 1-6).

DISTRIBUTION. Springer cites, "Beech River formation, Brownsport group, Niagaran; *Eucalyptocrinus* zone and glades, Decatur County, Tennessee." There is one specimen of this species (without arms) in the present collection. This came from locality 40-(123) in the lower half of the Brownsport formation.

Marsupiocrinus striatus Wachsmuth and Springer

Marsupiocrinus striatus Wachsmuth and Springer, 1897 (p. 732, pl. 75, fig. 18).

Marsupiocrinus striatus (Springer, 1926B, p. 58, pl. 14, figs. 7-13).

DISTRIBUTION. Springer cites, "Beech River formation, Brownsport group, Niagaran; Tuck's Mill and on glades, Decatur County, Tennessee." No specimens in the present collections.

Marsupiocrinus inflatus (Troost)

Cupellaecrinites inflatus Troost, 1850 (p. 61, nom. nud.).

Marsupiocrinus inflatus (Springer, 1926B, p. 58, pl. 15, figs. 1-8).

DISTRIBUTION. Springer cites same locality and horizon as *M. striatus*. No specimens in the present collections.

Marsupiocrinus verneuilli (Troost)*Cupellaecrinites verneuilli* Troost, 1850 (p. 61, nom. nud.).*Marsipocrinus verneuilli* (Springer, 1926B, p. 59, pl. 16, figs. 1-6).

DISTRIBUTION. Springer cites same locality and horizon as *M. striatus*. No specimens in the present collections.

Marsupiocrinus excavatus (Springer)*Marsipocrinus excavatus* Springer, 1926B (p. 60, pl. 16, figs. 7-7b).

DISTRIBUTION. Springer cites, "*Eucalyptocrinus* zone of Beech River formation, Brownsport group, Niagaran; Tuck's Mill, Decatur County, Tennessee." No specimens in the present collections.

Marsupiocrinus concavus (Springer)*Marsipocrinus concavus* Springer, 1926B (p. 60, pl. 16, fig. 8).

DISTRIBUTION. Springer cites the same horizon and locality as *M. excavatus*. No specimens in the present collections.

Marsupiocrinus stellatus (Troost)*Cupellaecrinites stellatus* Troost, 1849 (p. 419, nom. nud.).*Marsipocrinus stellatus* (Springer, 1926B, p. 60, pl. 17, figs. 1-10).

DISTRIBUTION. Springer cites same locality and horizon as *M. excavatus*. No specimens in the present collections.

Marsupiocrinus striatissimus (Springer)*Marsipocrinus striatissimus* Springer, 1926B (p. 61, pl. 18, figs. 1-7).

DISTRIBUTION. Springer cites, "*Eucalyptocrinus* zone of Beech River formation, Brownsport group, Niagaran; Tuck's Mill and glades, Decatur County, Tennessee." No specimens in the present collections.

Marsupiocrinus magnificus (Troost)*Cupellaecrinites magnificus* Troost, 1850 (p. 61, nom. nud.).*Marsipocrinus magnificus* (Springer, 1926B, p. 61, pl. 19, figs. 1-1b).

DISTRIBUTION. Springer cites: "Brownsport group, Niagaran; Decatur County, Tennessee." No specimens in the present collections.

Genus *Lecanocrinus* Hall, 1852*Lecanocrinus pisiformis* (Roemer)

Plate XII, figs. 18-20

Poteriocrinus pisiformis Roemer, 1860 (p. 54, pl. 4, figs. 7a-d).*Lecanocrinus pisiformis* (Springer, 1926B, p. 65, pl. 20, figs. 6-12).

DISTRIBUTION. Springer cites, "Beech River formation; Decatur County, Tennessee." The present collection contains nine specimens of this species. These came from the following localities: 19-(16); 39-(91), (118), (121); 40-(123); collected throughout the formation.

Lecanocrinus meniscus (Springer)

Lecanocrinus meniscus Springer, 1920 (p. 140, pl. 1, figs. 37a-c; 1926B, p. 65, pl. 20, figs. 15-15b).

DISTRIBUTION. Springer cites, "Beech River formation; Decatur County, Tennessee." No specimens in the present collections.

Genus *Anisocrinus* Angelin, 1878*Anisocrinus greenei* (Miller and Gurley)

Lecanocrinus greenei Miller and Gurley, 1896 (p. 52, pl. 3, fig. 28).

Anisocrinus greenei (Springer, 1926B, p. 66, pl. 20, figs. 16, 17).

DISTRIBUTION. Springer cites, "Louisville limestone; Jefferson County, Kentucky; Beech River formation, Decatur County, Tennessee." No specimens in the present collections.

Genus *Hormocrinus* Springer, 1920*Hormocrinus tennesseensis* (Worthen)

Centrocrinus tennesseensis Worthen, 1890 (p. 96, pl. 14, fig. 1).

Hormocrinus tennesseensis (Springer, 1926B, p. 66, pl. 22, figs. 1-3b).

DISTRIBUTION. Springer cites, "Beech River formation; Decatur County, Tennessee." No specimens in the present collections.

Genus *Asaphocrinus* Springer, 1920*Asaphocrinus bassleri* Springer

Asaphocrinus bassleri Springer, 1920 (p. 178, pl. 10, figs. 10-14; 1926B, p. 66, pl. 20, figs. 20, 21).

DISTRIBUTION. Springer cites, "Beech River formation; Decatur County, Tennessee." No specimens in the present collections.

Genus *Pycnosaccus* Angelin, 1878*Pycnosaccus patei* Springer

Pycnosaccus patei Springer, 1920 (p. 186, pl. 12, figs. 1-9; 1926B, p. 67, pl. 21, figs. 1-4).

DISTRIBUTION. Springer cites, "Beech River formation, Decatur County, Tennessee." No specimens in the present collections.

Pycnosaccus welleri Springer

Pycnosaccus welleri Springer, 1920 (p. 186, pl. 13, figs. 3-5; 1926B, p. 67, pl. 21, figs. 5-7).

DISTRIBUTION. Springer cites same locality and horizon as *P. patei*. No specimens in the present collections.

Pycnosaccus dubius Springer

Pycnosaccus dubius Springer, 1920 (p. 189, pl. 13, figs. 11a, b; 1926B, p. 68, pl. 21, figs. 9, 9a).

DISTRIBUTION. Springer gives the same horizon and locality as *P. patei*. No specimens in the present collections.

Genus *Sagenocrinites* Austin and Austin, 1842*Sagenocrinites clarki* (Springer)

Sagenocrinites clarki Springer, 1920 (p. 220, pl. 19, figs. 4a-d; 1926B, p. 68, pl. 22, figs. 4, 4a).

DISTRIBUTION. Springer cites, "Beech River formation; Decatur County, Tennessee." No specimens in the present collections.

Genus *Protaxocrinites* Springer, 1920*Protaxocrinites robustus* Springer

Protaxocrinites robustus Springer, 1920 (p. 349, pl. 45, figs. 9-11; 1926B, p. 70, pl. 22, figs. 6, 7).

DISTRIBUTION. Springer cites, "Beech River formation; Decatur County, Tennessee." No specimens in the present collection.

Genus *Gnorimocrinites* Wachsmuth and Springer, 1897*Gnorimocrinites cirrifer* Springer

Gnorimocrinites cirrifer Springer, 1920 (p. 335, pl. 47, figs. 7-12; 1926B, p. 70, pl. 22, figs. 8-10).

DISTRIBUTION. Springer cites, "Beech River formation; Decatur County, Tennessee." No specimens in the present collection.

Gnorimocrinites varians Springer

Gnorimocrinites varians Springer, 1920 (p. 356, pl. 47, figs. 13-17; 1926B, p. 70, pl. 22, figs. 11, 11a).

DISTRIBUTION. Springer gives the same locality and horizon as *G. cirrifer*. No specimens in the present collections.

Genus *Pisocrinites* De Koninck, 1858*Pisocrinites campana* Miller

Plate XII, figs. 12-13

Pisocrinites campana Miller, 1892 (p. 642, pl. 11, figs. 4, 5).

Pisocrinites campana (Springer, 1926B, p. 76, pl. 24, figs. 6-27).

DISTRIBUTION. Springer cites, "Dolomites of Wabash, Marion, Anderson, northern Indiana; Osgood and Laurel; St. Paul and other localities in southern Indiana. Laurel and Brownsport formations (*sic*). Rise Mill and Flatwoods, Perry County; Martin's Mill, Sinking Creek, Wayne County; Tuck's Mill and various glades in Decatur County, Tennessee."

The present collections contain a large number of specimens of this species. It is widely distributed in the area investigated and is most commonly found in the lower half of the Brownsport but ranges throughout the entire formation. The writer has made collections from the following localities and horizons: 4-(6); 15-(59); 26-(81); 32-(107); 36-(105); 39-(73), (91), (103), (121); 40-(123); 42-(93); 44-(133).

Pisocrinus benedicti Miller

Pisocrinus benedicti Miller, 1892 (p. 639, pl. 6, figs. 13-16).

Pisocrinus benedicti (Springer, 1926B, p. 77, pl. 24, figs. 28-36).

DISCUSSION. The distinction between *P. benedicti* and *P. campana* is based upon the size of the basals; in the latter the basals are large, extending well up the side of the calyx, while in the former the basals are small and not visible from the side. Many of the specimens which are here referred to *P. campana* are not well enough preserved to show the nature of the basals and it is possible that some of them may belong to the species *P. benedicti*.

DISTRIBUTION. Springer cites, "Dolomites of Wabash and Madison Counties, northern Indiana; Brownsport group of Decatur, Perry Counties, Tennessee; Bainbridge limestone, Ste. Genevieve County, Missouri." None of the specimens in the present collections have been referred to this species.

Pisocrinus quinquelobus Bather

Plate XII, figs. 14-16

Pisocrinus quinquelobus Bather, 1893 (p. 27).

Pisocrinus quinquelobus (Springer, 1926B, p. 77, pl. 23, figs. 16-29).

DISTRIBUTION. Springer cites, "Brownsport group of the Niagaran. Collected in all glades in Decatur County, and in excavations at 4 different localities along Beech River, and at 6 other localities in Perry and Wayne Counties, Tennessee. Also in the Bainbridge limestone, Ste. Genevieve County, Missouri, and Racine dolomite of the Chicago area." There are a large number of specimens of this species in the present collections. It is widely distributed and found throughout the Brownsport formation. Collections from the following localities and horizons: 4-(6), (9); 15-(59); 18-(2); 19-(16), (52); 28-(74); 29-(71), (77); 36-(105), (106); 39-(73), (91), (103), (121), (129); 40-(104), (123); 42-(93); 48-(130); 50-(70).

Pisocrinus gorbyi Miller

Pisocrinus gorbyi Miller, 1892 (p. 640, pl. 6, figs. 17-20).

Pisocrinus gorbyi (Springer, 1926B, p. 78, pl. 23, figs. 40-45)

DISCUSSION. Springer states that this species is "similar to *P. quinquelobus* except that the basals, instead of being hidden in a cavity, form a triangle, partly occupying a shallow depression and are more or less visible in a side view." Some of the specimens which are here referred to *P. quinquelobus* are not well enough preserved to show the nature of the basal plates and may belong to *P. gorbyi*.

DISTRIBUTION. Springer cites, "In dolomite of Wabash and Madison Counties, Northern Indiana; Lobelville formation; Flatwoods and Rise Mill, Perry County, Tennessee; Bainbridge limestone; Ste. Genevieve County, Missouri." No specimens in the present collections have been referred to this species.

Pisocrinus sphericus Rowley

Pisocrinus sphericus Rowley, 1904 (p. 270, pl. 16, figs. 8, 9).

Pisocrinus sphericus (Springer, 1926B, p. 79, pl. 23, figs. 30-36).

DISTRIBUTION. Springer cites, "Brownsport formation, Niagaran; clays at top of the Beech River and base of Lobelville; near Rise Mill, Perry County, and in

Decatur and Wayne Counties, Tennessee. Bainbridge formation; St. Genevieve County, Missouri." There are a few specimens of this species in the present collections from the following localities: 27-(87); 36-(105); 39-(91). All these came from the lower half of the Brownsport formation.

Pisocrinus tennesseensis (Roemer)

Plate XII, figs. 10-11

Symbathocrinus tennesseensis Roemer, 1860 (p. 55, pl. 4, figs. 6a-b).

Pisocrinus tennesseensis (Springer, 1926B, p. 79, pl. 24, figs. 1-5).

DISTRIBUTION. Springer cites, "Dixon beds and through the Brownsport, Niagaran. At four localities along Beech River in Decatur County, at Martin's Mill and another locality in Wayne County, and one in Perry County, Tennessee. Also Bainbridge limestone, St. Genevieve County, Missouri." There are 10 specimens of this species in the present collections, all the lower 30 feet of the formation. These came from the following localities: 4-(6); 26-(79); 36-(105); 39-(91), (103).

Genus *Zophocrinus* Miller, 1892

Zophocrinus howardi Miller

Zophocrinus howardi Miller, 1892 (p. 642, pl. 6, figs. 26-28).

Zophocrinus howardi (Springer, 1926B, p. 82, pl. 25, figs. 19-26).

DISTRIBUTION. Springer cites, "Laurel limestone; St. Paul and Greensboro, Indiana, and Beech River formation; Flatwoods, Perry County, Tennessee; perhaps Racine dolomite; Lemont, Illinois." No specimens in the present collections.

Genus *Myelodactylus* Hall, 1852

Myelodactylus ammonis (Bather)

Herpetocrinus ammonis Bather, 1893 (p. 49, pl. 2, figs. 54-63).

Myelodactylus ammonis (Springer, 1926B, p. 86, pl. 27, figs. 1-5a).

DISTRIBUTION. Springer cites, "Beech River formation; Decatur County; and Waldron shale; Newsom, Tennessee." Two specimens in the present collections are tentatively referred to this species. These came from localities 18-(2) and 39-(103) in the lower 45 feet of the Brownsport formation.

Myelodactylus brevis Springer

Myelodactylus brevis Springer, 1926A (p. 10, figs. 9, 9a; 1926B, p. 86, pl. 27, figs. 9, 9a).

DISTRIBUTION. Springer cites, "Beech River formation; Decatur County, Tennessee." No specimens in the present collections.

Myelodactylus extensus Springer

Plate XII, fig. 17

Myelodactylus extensus Springer, 1926A (p. 14, pl. 3, figs. 1-13; 1926B, p. 87, pl. 27, figs. 11-18).

DISTRIBUTION. Springer cites, "Beech River formation; Decatur County, Tennessee." There are two specimens of this species in the present collections from the Brownsport formation. These came from locality 11-(36).

Genus *Cremacrinus* Ulrich, 1886*Cremacrinus ulrichi* Springer

Cremacrinus ulrichi Springer, 1926B (p. 105, pl. 28, figs. 1, 2).

DISTRIBUTION. Springer cites, "*Eucalyptocrinus* zone of the Beech River formation, Brownsport group, Niagaran; Tuck's Mill, Decatur County, Tennessee." No specimens in the present collections.

Cremacrinus tubuliferous Springer

Cremacrinus tubuliferous Springer, 1926B (p. 106, pl. 28, figs. 3, 3a, b, 4, 4a, b, 5, 5a, 6).

DISTRIBUTION. Springer cites, "*Eucalyptocrinus* zone of Beech River formation, Brownsport group, Niagaran; Tuck's Mill, Decatur County, Tennessee." No specimens in the present collections.

Cremacrinus simplex Springer

Cremacrinus simplex Springer, 1926B (p. 107, pl. 28, figs. 8, 8a).

DISTRIBUTION. Springer cites the same locality and horizon as *C. tubuliferous*. No specimens in the present collections.

Genus *Eucheirocrinus* Meek and Worthen, 1869*Eucheirocrinus minor* Springer

Eucheiracrinus minor Springer, 1926B (p. 112, pl. 29, figs. 5, 5a, b).

DISTRIBUTION. Springer cites, "*Eucalyptocrinus* zone of Beech River formation, Brownsport group, Niagaran; Tuck's Mill, Decatur County, Tennessee." No specimens in the present collections.

Genus *Calceocrinus* Hall emend. Ringueberg, 1889*Calceocrinus foersti* Springer

Calceocrinus foersti Springer, 1926B (p. 116, pl. 29, figs. 7a, b, 8a, b, 9, 10, 11).

DISTRIBUTION. Springer cites, "*Eucalyptocrinus* zone of Beech River formation, Brownsport group, Niagaran; Tuck's Mill, Decatur County, Tennessee." No specimens in the present collections.

Calceocrinus bifurcatus Springer

Calceocrinus bifurcatus Springer, 1926B (p. 117, pl. 29, figs. 15, 15a, b).

DISTRIBUTION. Springer cites, "*Coccocrinus* zone of the Beech River formation, Brownsport group, Niagaran; west of Tuck's Mill, Decatur County, Tennessee." No specimens in the present collections.

Calceocrinus bassleri Springer

Calceocrinus bassleri Springer, 1926B (p. 117, pl. 29, figs. 12a, b, 13, 14; pl. 28, fig. 21).

DISTRIBUTION. Springer cites, "*Eucalyptocrinus* zone of Beech River formation, Brownsport group, Niagaran; Tuck's Mill, Decatur County, Tennessee." No specimens in the present collections.

Genus *Thalamocrinus* Miller and Gurley, 1895*Thalamocrinus ovatus* Miller and Gurley

Plate XII, figs. 8-9

Thalamocrinus ovatus Miller and Gurley, 1895 (p. 82, pl. 5, figs. 29-31).*Thalamocrinus ovatus* (Springer, 1926B, p. 131, pl. 26, figs. 2-5).

DISTRIBUTION. Springer cites, "Beech River formation, Niagaran; Decatur County, Tennessee." The present collections contain one specimen from the Brownsport formation. This came from locality 4-(6).

Thalamocrinus cylindricus Miller and Gurley*Thalamocrinus cylindricus* Miller and Gurley, 1895 (p. 82, pl. 5, figs. 32, 33).*Thalamocrinus cylindricus* (Springer, 1926B, p. 132, pl. 26, figs. 6-9).

DISTRIBUTION. Springer cites the same horizon and locality as *T. ovatus*. No specimens in the present collections.

Thalamocrinus globosus Springer*Thalamocrinus globosus* Springer, 1926B (p. 132, pl. 26, fig. 11).

DISTRIBUTION. Springer cites the same as *T. ovatus*. No specimens in the present collections.

Genus *Ampheristocrinus* Hall, 1882(?) *Ampheristocrinus typus* Hall*Ampheristocrinus typus* Hall, 1882 (p. 278, pl. 15, figs. 17, 18).(?) *Ampheristocrinus typus* (Springer, 1926B, p. 132, pl. 31, fig. 1).

DISTRIBUTION. Springer cites, "Beech River formation; Decatur County, Tennessee: type is from Waldron shale, Waldron, Indiana." No specimens in the present collections.

Genus *Cyathocrinus* Miller, 1821*Cyathocrinus decatur* Springer*Cyathocrinus decatur* Springer, 1926B (p. 134, pl. 31, fig. 2).

DISTRIBUTION. Springer cites, "Beech River formation, Niagaran; Decatur County, Tennessee." No specimens in the present collections.

Genus *Gissocrinus* Angelin, 1878*Gissocrinus delicatus* Springer*Gissocrinus delicatus* Springer, 1926B (p. 136, pl. 32, fig. 2).

DISTRIBUTION. Springer cites, "Beech River formation; Decatur County, Tennessee." No specimens in the present collections.

Gissocrinus magnibrachiatus Springer*Gissocrinus magnibrachiatus* Springer, 1926B (p. 136, pl. 32, figs. 3-6).

DISTRIBUTION. Springer cites, "Beech River formation; Tuck's Mill, Decatur County, Tennessee." No specimens in the present collections.

Genus *Botryocrinus* Angelin, 1878

Botryocrinus tenuidactylus Springer

Botryocrinus tenuidactylus Springer, 1926B (p. 137, pl. 31, fig. 9).

DISTRIBUTION. Springer cites, "Beech River formation; Decatur County, Tennessee." No specimens in the present collections.

Class CYSTOIDEA

Order RHOMBIFERA

Genus *Tetracystis* Schuchert, 1904

Tetracystis bifarius Amsden, n. sp.

Plate XII, figs. 1-4; Text fig. 28

DESCRIPTION. Calyx subprismatic; subquadrate in cross section with ambulacral grooves at the angles. Calyx plates 23 in number, arranged as shown in figure 28.

The food grooves lead right and left from the mouth and branch shortly to form



Figure 28. Plate arrangement in *Tetracystis bifarius*. Dashed lines are inferred. System of numbering after Schuchert (1904, p. 219, fig. 26).

four that run nearly straight down over the sides of the calyx, reaching almost to its base (pl. XII, figs. 3, 4). Each of these grooves is paved with a row of about 15 short, wide plates. At the upper edge of each of these plates is a small pit, probably indicating the facet to which a brachiole was attached. These alternate in position, being on the right edge of one plate and the left edge of the next. Each of these pits is joined to the main food groove by a short branch.

In the posterior interarray and about one-fourth the height of the calyx below its summit there is a relatively large, round anal opening (if anal plates were present they have been lost).

There are but two pore rhombs, one near the summit of both right and left interarrays. The left appears to have 8 and the right 10 hydrosphere folds. Between the mouth and the left pore rhomb there is a crescent-shaped opening (madreporite?), convex orad and having a slightly raised rim.

The lower margin of the basal plates is expanded to form an angular flange

overhanging the point of attachment of the stem which is relatively large (about 4 mm. in diameter).

Height of calyx 16 mm., greatest diameter 9 mm.

DISCUSSION. The species is quite similar to *T. fenestratus* (Troost, 1849, p. 419, nom. nud.; Schuchert, 1904, p. 219, pl. 34, figs. 6-8), but differs in having only 2 pore rhombs. Although there is only one specimen of *T. bifarius* in this collection it is remarkably well preserved and clearly shows that the third pore rhomb is absent. Silicification has obscured the junction of the plates in the upper part of the calyx and therefore the arrangement in this portion must be inferred. The first three cycles are, however, well shown and appear to be very similar to those in *T. fenestratus* (Schuchert, 1904, p. 219, text fig. 26).

Springer collected 8 specimens of *T. fenestratus* all of which possess 3 pore rhombs (1926B, p. 141, pl. 33, figs. 10-14). These show a surface ornamentation of rather prominent ridges and folds. The specimen in the present collection shows only extremely faint ornamentation and in this respect is more like the one figured by Schuchert. It is possible that this lack of ornamentation is due to surface abrasion.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. One specimen was found at locality 21-(25).

Genus *Caryocrinites* Say, 1825

Caryocrinites milliganae (Miller and Gurley)

Caryocrinites milliganae Miller and Gurley, 1896A (p. 63, pl. 5, figs. 3-4).

Caryocrinites milliganae (Springer, 1926B, p. 143, pl. 33, figs. 29-36).

DISCUSSION. There are a number of calyces of this species in the present collections but they are all partially silicified and not well preserved. Springer has figured several well preserved individuals.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee: common and widespread, distributed throughout the formation. Collections at the following localities and horizons: 4-(14); 8-(58); 11-(56); 17-(62); 19-(19), (52); 22-(15); 26-(81), (79) (plates only); 36-(105) (plates only); 39-(91), (103), (129); 40-(123); 44-(133); 45-(120) (plates only); 50-(70).

Class BLASTOIDEA

Genus *Troosticrinus* Shumard, 1866

(equals *Troostocrinus* Meek and Worthen, 1868)

Troosticrinus reinwardti (Troost)

Plate XII, figs. 5-7; Text fig. 29

Pentremites reinwardtii Troost, 1835 (p. 224, pl. 10, figs. 9-12).

Troostocrinus reinwardtii (Etheridge and Carpenter, 1882, p. 248).

Troostocrinus reinwardti (Springer, 1926, p. 141, pl. 33, figs. 1-8).

DISCUSSION. There are about 20 specimens of this species in the collections although many of these are rather poorly preserved as the result of silicification. A specimen of average size is shown on plate XII, figures 5, 6, and an enlarged view of the ambulacral area of another specimen is shown on figure 7 of the same

plate. A section of the calyx showing the number and arrangement of the hydrospires is shown in text fig. 29.

DISTRIBUTION. Most of the specimens in the collections were found in the lower half of the formation. However, two have been found in the upper half. Localities and horizons as follows: 4-(32), (14); 8-(57); 17-(62); 19-(19), (52), (61); 21-(25); 36-(105); 39-(103), (91), (121); 44-(133); 48-(108); 53.

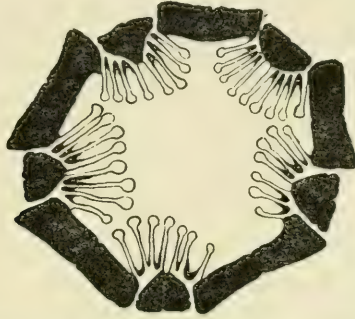


Figure 29. Section of the calyx of *Troosticrinus reinwardti* (Troost) showing hydrospires ($\times 8$). Locality 8-(57). Y.P.M. 17509.

PHYLUM COELENTERATA

Class ANTHOZOA

Subclass SCHIZOCORALLA Okulitch, 1939

Genus *Plasmopora* Edwards and Haime, 1849

Plasmopora follis Edwards and Haime

Plate XIII, figs. 1-4

Plasmopora follis Edwards and Haime, 1851 (p. 223, pl. 16, figs. 3, 3a; Roemer, 1860, p. 24, pl. 2, figs. 6, 6a).

DESCRIPTION. The corallum of this species is variable although it tends to be pyriform, expanding upwards from a small base. Its size is also variable, the largest specimen in the collection (pl. XIII, fig. 1) measuring 65 mm. from base to top and having a diameter of 45 mm. at the expanded portion. The corallites are subcylindrical and range from 1.5 to 2 mm. in diameter. They are not in conjunction with one another but are separated by dissepimental tissue (pl. XIII, figs. 2-4). The corallite wall is rather thick and is probably somewhat porous. Each corallite bears 12 septa in the form of rows of spines (pl. XIII, fig. 2). The corallites are crossed by somewhat irregular and very thin tabulae which are unevenly spaced (pl. XIII, fig. 2). The space between these corallites is filled with dissepimental tissue, the dissepiments being irregularly arranged and convex upwards. Many of these dissepiments have vertical plates on their upper surface but these do not extend upward to the next highest dissepiment.

DISCUSSION. This species was based upon specimens which Edwards and Haime secured from Perry County, Tennessee, and which probably came from the

Brownsport. The specimens in the collections under study agree very well with their description. In the development of the septa and in the strong development of dissepimental tissue this species is probably rather closely allied to the genus *Proparia* (Edwards and Haime, 1849, p. 262).

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee; Louisville limestone near Louisville, Kentucky; for other possible localities see Bassler (1915, p. 983) and Shimer and Shrock (1944, p. 103).

This is not a very common form in the Brownsport formation. Specimens from the following localities and horizons: 11-(36); 13-(41); 23-(64). These collections came from zones ranging from 30 to 85 feet above the base of the formation.

Genus *Cosmolithus* Lindstrom, 1889

Cosmolithus sewellensis Amsden, n. sp.

Plate XIII, figs. 5-9

DESCRIPTION. The corallum of this species is thin, plate-like and in part encrusting, commonly attaining a diameter of 10 or 12 cm. and rarely exceeding 10 mm. in thickness. It is dimorphic with macrocorallites less than 1 mm. in diameter and very tiny microcorallites of which 6 or 7 span a distance of only 2 mm. The walls of the corallites are not independently calcified, the macrocorallites and microcorallites sharing a common wall. Macrocorallites possess 12 septa which extend to the center to form a reticulate mass; the walls are indented at each septum (pl. XIII, fig. 6). A longitudinal section through the center of a macrocorallite appears vesicular because of the union of the septa (pl. XIII, figs. 8, 9). If there are tabulae present in the macrocorallites they are only poorly developed. The microcorallites are slender, polygonal tubes which are abundantly tabulate, the tabulae being horizontal or slightly irregular and varying somewhat in their spacing in different parts of the colony (pl. XIII, figs. 8, 9).

DISCUSSION. The corallum of this species is several times thicker than that of *C. ornatus* (Lindstrom, 1899, p. 68, pl. 5, figs. 4-11) and the macrocorallites are considerably larger. *C. halysitoides* (ibid., p. 69, pl. 5, figs. 12-18) has slightly larger macrocorallites which are spaced closer together. Both *C. ornatus* and *C. halysitoides* show considerable variation in the size of the microcorallites while those of *C. sewellensis* are fairly uniform in size.

DISTRIBUTION. Brownsport formation of western Tennessee. This species is common at locality 11-(36) where it is found in the upper 40 feet of the formation. It has also been found at locality 51-(69).

Genus *Heliolites* Dana, 1840

Heliolites spongiosus Foerste

Plate XIV, fig. 5-8

Heliolites spongiosus Foerste, 1906 (p. 303, pl. 3, fig. 3; pl. 4, fig. 4; pl. 5, fig. 5).

DESCRIPTION. Corallum thin and flat; fragments several inches across indicate that the maximum diameter may have been a foot or more, yet the thickness is commonly between 1 and 2 cm. The colony is dimorphic, the macrocorallites averaging slightly less than 2 mm. in diameter and the microcorallites about one-fifth as much. The walls of the corallites are not independently calcified, adjacent corallites sharing a common wall. Each of the macrocorallites is surrounded by a ring

of microcorallites and the microcorallites also fill the remaining space. The macrocorallites have no septa although the wall is flexed slightly outwards to meet the common wall between each two adjacent microcorallites, and is slightly convex inward between. This gives the open corallite the superficial appearance of having a dozen or more septal ridges but these can hardly have any homology with true septa for they vary in number and correspond only with the number of contiguous microcorallites. Both macrocorallites and microcorallites bear flat, transverse tabulae of which 12 to 20 occupy a distance of 5 mm.

DISCUSSION. The material from the Brownsport formation agrees fairly well with Foerste's description and figures based upon specimens from the Waco limestone. The shape of the corallum and arrangement and structure of the corallites appear to be identical. The only difference seems to be that the macrocorallites in the Brownsport specimens average only slightly less than 2 mm. while those described by Foerste average about 1.5 mm.

DISTRIBUTION. The specimens studied by Foerste came from the Waco limestone of Kentucky; the writer's specimens from the Brownsport formation of western Tennessee. This species is common at locality 11-(36) where it is found in the upper 40 feet of the formation; also found at 19-(19) and 36-(105); at the last mentioned locality it occurs in the lower 16 feet of the Brownsport.

Heliolites tennesseensis Amsden, n. sp.

Plate XIV, figs. 1-4

Plasmopora elegans (Davis, 1885, pl. 1, figs. 11-13; non *Heliolites elegans* Hall, 1852, p. 130, pl. 36, figs. 1a-g).

DESCRIPTION. The corallum of this species is small, hemispherical to pyriform, with most specimens showing clear evidence of attachment to a crinoid stem. The largest specimen in the collection has a maximum diameter of 35 mm. but most specimens are less than 25 mm. in diameter. The colony is dimorphic, the macrocorallites averaging about 2 mm. in diameter and the microcorallites about one-fourth of this. The walls are not independently calcified, adjacent corallites having a common wall. The macrocorallites are circular in cross-section and spaced rather close together, usually less than 1 mm. apart. There are 12 septa present which are largely reduced to rows of spines (pl. XIV, figs. 2, 3). The tabulae are flat and rather widely spaced, about 5 occupying a space of 6 mm. The microcorallites are much more irregular in cross-section than are the macrocorallites and have the tabulae spaced much closer together, there being about 7 to 8 in a distance of 4 mm.

DISCUSSION. This species differs from *H. interstinctus* (Linnaeus, 1767, p. 1267) in its small pyriform corallum and in its closely spaced macrocorallites. *H. perelegans* (Whitfield, 1900, p. 21, pl. 1, fig. 2) has macrocorallites of about the same size and spacing as *H. tennesseensis* but has a large hemispherical corallum. *H. occidentalis* (Stauffer, 1930, p. 108, pl. 13, figs. 5-6) has a much smaller corallum and its macrocorallites are spaced 2.5 to 3 mm. apart. *H. elegans* (Hall, 1852, p. 130) has a massive, hemispherical corallum.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. This is a rather common species which has been collected from the following localities: 4-(6), (9), (44); 18-(2); 28-(74); 38-(90).

Heliolites distans Foerste

Plate XV, figs. 6-9

Heliolites subtubulatus distans Foerste, 1906 (p. 305, pl. 3, fig. 5B; non *H. distans* Dun, 1927, p. 258, pl. 19, figs. 3-6).

Heliolites interstincta (Roemer, 1860, p. 23, pl. 2, figs. 5, 5a; non Linnaeus, 1767).

DESCRIPTION. This species has a rather flat, thin corallum with a small area of attachment and with the rest of the base covered by a wrinkled epitheca. The most complete specimen has a diameter of about 6 inches and is an inch and a half thick. The colony is dimorphic, the macrocorallites averaging slightly over 1 mm. in diameter and the microcorallites about one-fourth of a millimeter. The walls are not independently calcified, adjacent corallites sharing a common wall. The macrocorallites are cylindrical and have no septa although the wall is slightly flexed outward to meet the common wall between each two adjacent microcorallites, and is slightly flexed inward between (pl. XV, figs. 7, 8). The macrocorallites are rather closely spaced, about 5 occupying a space of 10 mm. The tabulae in the macrocorallites are flat and close together, about 10 in a distance of 2 mm. The microcorallites are polygonal in cross-section and very small, there being about 8 of them in a distance of 2 mm. The tabulae of the microcorallites are well developed and have about the same spacing as do those of the macrocorallites.

DESCRIPTION. Foerste's description of this species was based upon material from the Waco limestone and the Brownsport specimens agree quite well with this description. He considered it to be a variety of *H. subtubulatus* although he noted that the specimens which he studied differed from the type specimens "in the smaller size of the corallites, the greater distance between them, and the absence of any unusual thickness in the case of the walls." These differences seem to be sufficient to warrant making *H. distans* a distinct species.

DISTRIBUTION. Foerste's specimens came from the Waco limestone of Kentucky; the collections of the writer are from the Brownsport formation of western Tennessee. This is a common species in the Brownsport and has been found at the following localities: 10-(26); 11-(36); 28-(74); 41-(86); 46-(84); 48-(113). These collections from the upper 40 feet of the Brownsport.

Heliolites nucella Foerste

Plate XV, figs. 1-5

Heliolites subtubulatus nucella Foerste, 1906 (p. 305, pl. 3, fig. 5A).

DESCRIPTION. The corallum is low and spreading with the upper surface commonly gently convex and the lower surface flat or even concave. The corallum generally has a small area of attachment with the rest of the undersurface covered by a wrinkled epitheca. One of the largest specimens in the collection measures about 6 inches across and has a maximum thickness of 1 inch. The colony is dimorphic, adjacent corallites sharing a common wall. The macrocorallites have a diameter of a little over two-thirds of a millimeter while the microcorallites are slightly less than a quarter of a millimeter in diameter. The macrocorallites are spaced somewhat further apart than are those of *H. distans*, about 3 occupying a space of 10 mm. There are no septa present; the tabulae of both macrocorallites and microcorallites are flat, with about 5 or 6 in a distance of 1 mm.

DISCUSSION. This species differs from *H. distans* in its smaller macrocorallites

which are spaced further apart. The macrocorallites of *H. nucella* have a diameter of about two-thirds of a millimeter and are spaced about 2 mm. apart; those of *H. distans* are a little over a millimeter in diameter and about 1.5 mm. apart. Also the microcorallites of *H. nucella* are slightly smaller. In general *H. nucella* has a meniscus-shaped corallum while *H. distans* is a flatter form but both species show considerable variation in shape.

H. nucella seems clearly to represent a species distinct from *H. subtubulatus* (see discussion under *H. distans*).

DISTRIBUTION. Foerste's collections are from the Waco limestone of Kentucky; the writer's specimens from the Brownsport of western Tennessee. This is a common species from the Brownsport and has been found at the following localities and horizons: 19-(43); 16-(31); 13-(41); 14-(42); 28-(74); 32-(101); 38-(90); 48-(113); these collections from the upper 50 feet of the formation.

"TABULATA"

It is recognized that the so-called "tabulate" corals do not constitute a natural subdivision. Since no satisfactory classification has been proposed the above term will be used for convenience in separating this group from the Tetracoralla. It is possible that the genera here called *Coenites* and *Cladopora* may belong to the phylum Bryozoa.

Genus *Favosites* Lamarck, 1816

Favosites brownsportensis Amsden, n. sp.

Plate XVI, figs. 1-3

Calamopora gothlandica (Roemer, 1860, p. 18, pl. 2, fig. 9; non Lamarck, 1816, p. 204).

DESCRIPTION. This species has a large flat, plate-like corallum which probably grew with its base encrusting the sea floor since none of the specimens show any epitheca. There are incomplete specimens which measure as much as 7 or 8 inches across, indicating that the maximum diameter may have reached a foot or more although the thickness probably did not exceed 2 inches. The corallites are rather uniform in size and are generally hexagonal in cross-section although rare individuals may be found which have as few as 4 or as many as 7 sides. The corallites average about 3 mm. in diameter, this species having the largest corallites of any of the *Favosites* in the collections. Adjacent corallite walls are independently calcified and therefore distinct from one another as may be seen in figure 1 of plate XVI. There is no trace of any septa (pl. XVI, figs. 1, 3); the tabulae are flat to very slightly convex upwards and are rather closely spaced, there being 6 or 7 in a distance of 5 mm. (pl. XVI, fig. 2). The mural pores are numerous and fairly large with some of them attaining a diameter of .3 mm. These are apparently confined to the walls, none having been observed in the corners of the corallites.

DISCUSSION. The corallites of *F. brownsportensis* are larger than those of *F. niagarensis* (Hall, 1852, p. 125, pl. 34a (bis), figs. 4a-4i) and the corallum is plate-like whereas in *F. niagarensis* it is spherical or club-shaped. *F. declinatus* (Foerste, 1906, p. 300, pl. 2, figs. 4a, b, pl. 4, fig. 4) has a much smaller corallum with smaller corallites and septa in the form of granules. *F. favosus* (Goldfuss, 1826, p. 77, pl. 26, fig. 2a-c) has corallites marked with longitudinal furrows and *F. favosus integratabulatus* (Swartz, 1913, p. 214, pl. 24, figs. 1, 2) has a spherical corallum with the base restricted.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. This species is common and widespread; found at the following localities and horizons: 2-(38), (135); 4-(6), (14), (9), (44); 11-(36); 10-(26); 13-(41); 14-(42); 16-(28); 21-(25); 28-(74); 31-(96); 38-(90); 43-(94); 46-(84); from the upper 40 feet of the formation at all localities except 38 and 4 where it was found in the lower half.

Favosites clavatulus Amsden, n. sp.

Plate XVI, figs. 4-9

Favosites cristatus (Davis, 1885, pl. 9, figs. 1-5; non Edwards and Haime, 1851, p. 242).

DESCRIPTION. The corallum of this species is generally pyriform to clavate although a few specimens are hemispherical with the base only slightly restricted. The corallites open out on all parts of the corallum except for the restricted base (pl. XVI, figs. 4, 5, 8). There appears to have been no tendency towards the development of a dendritic corallum. They are all small in size, the largest specimen in the collection measuring 27 mm. long and 16 mm. at the greatest diameter. The corallites are polygonal in cross-section and show some variation in size, the average being slightly over a millimeter in diameter. Adjacent corallite walls are independently calcified and therefore distinct from one another. The corallites arise in the central part of the corallum and bend outwards, approaching the surface at a fairly high angle (50 to 90 degrees). No septa have been observed and the tabulae are much reduced in number, being located 1 to 2 mm. apart. A few small mural pores are present which are located on the walls of the corallites.

DISCUSSION. *F. cristatus* (Edwards and Haime, 1851, p. 242) has a dendritic corallum while *F. cristatus major* (Davis, 1885, pl. 24, fig. 3) is a larger species and has "squamous walls." *F. pyriformis* (Hall, 1852, p. 123, pl. 34A, figs. 1a-4) has a larger corallum which is more spherical. *F. forbesi occidentalis* differs from *F. clavatulus* in having much greater variation in the size of the corallites, the larger corallites reaching a diameter of 3 mm. *F. marylandicus* (Prouty, 1923, p. 397) has a dendroid colony with the corallites very unequal in size.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. This is not a very widely distributed species; specimens in this collection from the following localities: 4-(1), (9), (14), (44); 18-(2); 39-(91); 42-(93); 47-(85); collected throughout the formation. It may be present in the Henryhouse shales of Oklahoma. Also present in Louisville formation.

Favosites louisvillensis? Davis

Plate XVII, figs. 1-4; Text fig. xxx

Favosites louisvillensis Davis, 1885 (pl. 9, fig. 6; non? Greene, 1904, p. 186, pl. 56, fig. 2).

Favosites gothlandica (Roemer, 1860, p. 19, pl. 2, fig. 11, non fig. 9; non Lamarck, 1816, p. 204).

DESCRIPTION. This species has a very large, flattened, plate-like corallum which probably grew with its base encrusting the sea floor since none of the specimens in the collections show any basal epitheca. The coralla commonly exceed a foot in diameter and there is one large specimen (fig. xxx) which attains a diameter of 3 feet and has a maximum thickness of about 2.5 inches. The corallites are fairly uniform in size and have an average diameter of about 1.5 mm. They are generally hexagonal in cross-section with the walls of contiguous corallites not amalgamated.

There are no septa; the tabulae are thin and flat, 6 or 7 of them occupying a space of 5 mm. The mural pores are tiny, generally less than .1 mm. in diameter and commonly located near the corners.

DISCUSSION. Davis's species, *F. louisvillensis*, was based upon specimens from the Louisville limestone of Kentucky. Unfortunately he did not give any description or figure any thin sections, but a comparison of the writer's specimens with the one illustrated by him shows that both have corallites which are similar in size and shape and both have a large plate-like corallum. Bassler has suggested (1915, p. 532) that *F. louisvillensis* of Greene (1904, p. 186, pl. 56, fig. 2; Greene proposed this as a new species being unaware that the name was preoccupied) is synonymous with *F. louisvillensis* of Davis but the specimens studied by Greene appear to have somewhat larger corallites. *F. hisingeri aplata* (Foerste, 1906, p. 299, fig. 2; pl. 4, fig. 5) is similar to the Brownsport form but has well developed septa.

DISTRIBUTION. The specimens studied by Davis are from the Louisville limestone of Kentucky; the writer's collection from the Brownsport formation of western Tennessee; also present in the Henryhouse formation of Oklahoma. This species is abundantly represented in the Brownsport and has been found throughout the formation although it is most common in the upper 40 feet. There are collections from the following localities and horizons: 2-(38); 4-(6), (9), (14), (44); 10-(26); 11-(36); 13-(41); 14-(42); 16-(28), (31); 18-(65), (66); 23-(64); 28-(74); 31-(96); 36-(105); 38-(90); 41-(86); 43-(94); 46-(84), (110); 47-(85); 48-(108), (113), (130).

Favosites beechensis Amsden, n. sp.

Plate XVII, figs. 5-10

DESCRIPTION. The corallum of this species is hemispherical or button shaped with a convex upper surface and a convex to cone-shaped base. The basal point of attachment is usually small with the remainder of the under surface covered with epitheca (pl. XVII, figs. 5-7). The corallum is small, the largest specimen in the collection measuring 25 mm. in diameter. The corallites are packed close together and fan outwards from the central and basal parts of the corallum, approaching the surface at an angle of about 90 degrees (pl. XVII, figs. 5, 7, 9). They are polygonal in cross-section with the walls of contiguous corallites not amalgamated. The corallites at the surface are fairly uniform in size and average slightly over a millimeter in diameter. No septa have been observed; the tabulae are flat and well developed, with 4 or 5 occupying a space of 5 mm. The specimens studied show only one questionable mural pore but they are silicified and the wall structure is not well preserved.

DISCUSSION. *Favosites beechensis* differs from *F. clavatulus* in that the corallum of the former is hemispherical or button shaped while the latter is clavate or pyriiform. Furthermore, in *F. beechensis* the corallites form rather straight tubes radiating out from the basal part of the corallum and possessing numerous tabulae while in *F. clavatulus* the corallites bend outwards from the central portion of the corallum and have only a few tabulae (compare pl. XVII, fig. 9 with pl. XVI, fig. 6). *F. pyriiformis* (Hall, 1852, p. 123, pl. 34A, figs. 1a-e) has a much larger corallum.

DISTRIBUTION. Silurian, Brownsport of western Tennessee; this species or a very closely related form is found in the Henryhouse shale of Oklahoma. It is not common in the Brownsport; collections from the following localities: 2-(38); 4-(6); 12-(27); 18-(13); 26-(81); 38-(90); 42-(93) collected throughout the formation.

Favosites discoideus (Roemer)

Plate XVIII, figs. 6, 7, 9; Plate XXXIV, figs. 13, 15

Calamopora forbesi var. *discoidea* Roemer, 1860 (p. 19, pl. 2, figs. 10, 10a, 10b).*Favosites discoidea* (Foerste, 1903, p. 712).*Favosites discoideus* (Bassler, 1915, p. 528).

DESCRIPTION. This species has a hemispherical corallum with a gently convex upper surface and a convex to cone-shaped base. The basal point of attachment is small and the remainder of the under surface is covered with epitheca. All the specimens in the collections are small, the largest measuring 55 mm. in diameter; the specimen shown in figures 6 and 7 of plate XVIII is the smallest one. The corallites fan outwards from the central and basal part of the colony as rather straight-walled tubes which are polygonal in cross-section with the walls of contiguous corallites in close contact but not amalgamated. There is some variation in the size of the corallites but they average about 2.5 mm. in diameter. There are no septa present; the tabulae are flat and spaced about 1 mm. apart. The mural pores are numerous and rather irregular in their spacing, usually about a millimeter apart. They are rounded and comparatively large, having a diameter of about a quarter of a millimeter. These pores are located on the walls of the corallite about midway between two corners although they show some variation in their position.

DISCUSSION. These specimens agree quite well in size and shape of the corallum and corallites with those described and figured by Roemer. In Roemer's figure 10 of plate 2 the corallites are shown as possessing septa but this is evidently an error since none of the specimens collected show any trace of septa.

The general shape and structure of the corallum of this species is quite similar to that of *F. beechensis* but the corallites of *F. discoideus* are twice as large as those of *F. beechensis*. Furthermore the corallum of *F. discoideus* attains a considerably greater size.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. This is not a common or widely distributed species; collections from the following localities and horizons: 19-(52); 28-(74); 31-(96); 39-(73); 49-(132) found throughout the formation.

Favosites obpyriformis Foerste*Favosites obpyriformis* Foerste, 1909B (p. 100, pl. 4, fig. 74).

DISCUSSION. There is one specimen in the collections which seems to agree very well with Foerste's description and illustration of this species. It has a somewhat globular corallum with a maximum diameter of about 45 mm. and a maximum thickness of 33 mm. The corallites vary somewhat in size, ranging from 2 to 3 mm. in diameter. The basal portion is not very well preserved and therefore it is not possible to determine whether it was covered with epitheca.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. One specimen from locality 28-(74).

Genus *Cladopora* Hall, 1851*Cladopora?* *brownsportensis* Amsden, n. sp.

Plate XIX, figs. 1-6

?Cladopora laqueata (Davis, 1885, pl. 48, figs. 8, 9; non Rominger, 1876, p. 46, pl. 18, fig. 3).

DESCRIPTION. This species has a dendritic corallum with anastomosing branches on which the corallite apertures occupy all sides. The branches are circular to slightly oval in cross-section with an average diameter of about 5 mm. The corallites arise in the central part of the corallum as thin-walled tubes which gradually bend outwards and approach the surface at a low angle (pl. XIX, figs. 5, 6). As the corallites progress out from this central core they become abruptly flattened and much thicker walled. A cross-section of one of the branches thus appears to have a central core of rather thin-walled corallites with a polygonal outline surrounded by and rather sharply set off from an outer zone of much thicker-walled corallites which are elliptical in outline (pl. XIX, fig. 5). The corallites in this central zone have a diameter ranging from one-third to one-fourth of a millimeter, the corallite openings being several times as large as the surrounding wall. In the outer zone the corallites are elliptical or slit-like with a length ranging from two-thirds to one millimeter and a width of about one-fourth of a millimeter. The wall between the corallites has thickened in this part until it is about equal to the width of the corallite opening. The opening of the corallite has become somewhat restricted in this outer zone by what appears to be a secondary deposit. When viewed in cross-section (pl. XIX, fig. 5) this secondary deposit appears to fill the ends of the long diameter of the corallites, thus reducing the actual opening to a size which is about the same as that of the corallites in the central core. Some of the corallites in the central core show a similar secondary deposit but here it is much thinner. Contiguous corallites in the inner zone appear to have distinct walls but in the outer zone this distinction is lost and the walls appear to be amalgamated. The writer has prepared several thin sections of this species but has not seen any tabulae, septa or mural pores.

DISCUSSION. The reference of this species to *Cladopora* is questionable since the internal characters of this genus have not been clearly defined. Hall's description of the genus *Cladopora* (1851, p. 400) and of the genotype *C. seriata* (Hall, 1852, p. 137, pl. 38, figs. 1a-m) is inadequate but does seem to show some features in common with *C. brownsportensis*. The corallum of *C. seriata* is dendritic and has the corallites opening obliquely onto the surface. The corallites seem to be somewhat compressed and Hall states that they lack transverse septa. It is not known whether or not the corallites in the central portion of *C. seriata* form a core of thin-walled, polygonal tubes.

Lang, Smith and Thomas (1940, p. 39) state that the genotype of *Cladopora* is a species of *Coenites* but they do not give any reason for this statement. *Coenites* was proposed by Eichwald in 1829 but he did not give an adequate description of the generic characters. In 1879 Nicholson (p. 135, pl. 6, figs. 5, 5b) described and figured specimens which he believed to be conspecific with the genotype *Coenites juniperinus*. He noted: "Corallites nearly vertical in the center of the branches, with thin wall, and about one-sixth of a line in diameter; gradually diverging in their upward course till they reach a point from one-quarter to half a line from the surface, when they bend suddenly outwards, their walls being greatly thick-

ened, and the visceral chamber reduced to a mere slit." This description would agree very well with the structure of the specimens of *Coenites verticillatus* (pl. XX, figs. 3-5) from the Brownsport, but does not seem to fit the specimens of *Cladopora? brownsportensis*. It should be noted, however, that the specimens which Nicholson studied came from the Wenlock limestone of Dormington Quarry, Stoke-Edith, and may not be conspecific with Eichwald's type material which came from the drift of Lithuania. A comparison of Hall's type material with that of Eichwald may well show that *Cladopora seriata* is congeneric with *Coenites juniperinus*. It does seem that the specimens here described as *Cladopora? brownsportensis* and *Cladopora? reticulata* have a quite different internal structure from the specimens described as *Coenites verticillatus* and that the two forms should be generically separated. For the purpose of distinguishing between these two forms the terms *Cladopora?* and *Coenites* are here used although it is recognized that further study may show the necessity for a new generic name.

C.? brownsportensis is somewhat similar to *Alveolites* in its oblique and compressed corallites. The genotype of *Alveolites* is *A. suborbicularis* (Lamarck, 1801, p. 376; Lecompte, 1936, pl. 2, figs. 1, 2 has figured two thin sections of Goldfuss' types of *Calamopora spongites tuberosa* which Edwards and Haime 1851, p. 219, consider to be conspecific with *A. suborbicularis*) and does not appear to have any progressive thickening of the walls or any central, thin-walled zone; however, Lecompte (1939, p. 17) has included some thick-walled forms in his redefinition of *Alveolites*.

The genus *Thamnopora* (Steiniger, 1831, p. 10) does not appear to have the corallites as obliquely directed or as compressed as they are in *C.? brownsportensis*. *Pachypora* is considered to be a synonym of *Thamnopora* (Lang, Smith and Thomas, 1940, p. 133).

This species differs from *Cladopora laqueata* (Rominger, 1876, p. 46, pl. 18, fig. 3) in that the Brownsport specimens have larger branches and smaller corallite apertures. The Louisville specimens which Davis identified as *Cladopora laqueata* appear to be quite similar to the Brownsport forms but in the absence of any detailed description such a comparison must be provisional.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee and possibly from the Louisville limestone of Kentucky. This is a rare species in the Brownsport formation and has been found only at localities 11-(36) and 28-(74).

Cladopora? reticulata Hall

Plate XVIII, figs. 4, 5, 8

Cladopora reticulata Hall, 1852 (p. 141, pl. 39, figs. 3a-e).

DESCRIPTION. The corallum consists of rounded to slightly oval branches which anastomose to form a reticulate colony. The branches range from 1 to 1.5 mm. in diameter with the corallite aperture occupying all sides. The apertures are round to slightly elliptical and are very small, ranging from one-fourth to one-third of a millimeter in diameter, and are spaced from a half to one millimeter apart. The corallites arise in the central part of the colony as thin-walled tubes which gradually diverge and approach the surface of the corallum at an oblique angle. As the corallite progresses out from the center the walls thicken greatly; adjacent corallite walls are distinct in the central part of the colony but this becomes less sharply defined towards the surface. No tabulae, mural pores or septa have been seen.

DISCUSSION. This species differs from *C.? brownsportensis* in having much

smaller branches and a more reticulate colony. Furthermore, the corallite apertures of *C.?* *brownsportensis* are compressed while those of *C.?* *reticulata* are almost round. The internal structure of these two species is very similar. The genus *Cladopora* and its relation to *Coenites* have been discussed under our *Discussion of Cladopora?* *brownsportensis* and *Coenites verticillatus*.

DISTRIBUTION. Hall's specimens came from the Louisville limestone of Kentucky; the specimens under study are from the Brownsport formation and the writer has also identified this species in the Henryhouse of Oklahoma; for other localities see Bassler (1915, p. 224). There are only 8 specimens of this species in the Brownsport collections; from the following localities and horizons: 11-(36); 28-(74); 38-(90); 47-(85); 36-(105); 51-(69).

Genus *Coenites* Eichwald, 1828

Coenites verticillatus (Winchell and Marcy)

Plate XX, figs. 3-5

Cladopora verticillata Winchell and Marcy, 1865 (p. 84, pl. 2, fig. 2).

Coenites verticillata (Davis, 1885, pl. 46, figs. 1-4).

DESCRIPTION. There are only 2 fragmentary specimens in this collection. The largest of these consists of a stem about 5 mm. in diameter which has 2 circular fronds branching off from it, the fronds being located about 25 mm. apart (pl. XX, fig. 5). The other specimen is slightly smaller, the diameter of the stem being about 4 mm. and the fronds spaced 18 mm. apart. The corallite apertures occupy all sides of the stem and the upper and lower surfaces of the fronds. These specimens have a somewhat abraded surface and therefore it is not possible to determine the exact nature of the corallite openings. The corallites originate in the central part of the colony and bend gradually outwards until they are about a millimeter from the surface; at this point they are abruptly bent so that they approach the surface of the corallum at approximately right angles (pl. XX, fig. 3). The corallites in the inner zone are polygonal in cross section and small, about 4 of them occupying a space of 1 mm. In this central zone the walls of contiguous corallites are distinct and relatively thin, being somewhat less than the diameter of the corallite opening. At the point where the corallite is sharply flexed the wall thickens greatly so that although the corallite openings retain about the same diameter that they had in the inner zone, the apertures are spaced about three-fourths of a millimeter apart. In this outer margin the walls of adjacent corallites appear to be amalgamated. The corallum is thus divided into two distinct zones as may be seen in the cross and longitudinal sections shown in figures 3 and 4 of plate XX. The corallites apparently have the same structure in the fronds that they have in the stem, being divided into an inner and outer zone. Tabulae are common in the central zone, varying some in their spacing but averaging about 1 mm. apart; none have been observed in the outer, thick-walled area. There appear to be a few scattered mural pores in the central, thin-walled portion but none have been identified in the outer zone. No septa have been observed.

DISCUSSION. The internal structure of these specimens of *Coenites verticillatus* is quite different from that seen in the specimens of *Cladopora?* *brownsportensis* and *C.?* *reticulata*. The corallites of *C. verticillatus* arise in the central part of the corallum as thin-walled tubes which bend gradually outwards until they are about a millimeter from the surface; at this point the corallites are abruptly bent, the walls thicken greatly, and they approach the surface of the corallum at about

right angles. In *Cladopora? brownsportensis* and *C.? reticulata* the corallites arise in the center of the corallum as thin-walled tubes and bend gradually outwards, continuing this course and intersecting the surface of the corallum at an oblique angle. There is an outer zone of rather thick-walled corallites which is rather sharply set off from the inner core of thin-walled corallites but the corallites do not show any abrupt bend as they approach the surface. Furthermore, *Coenites verticillatus* is abundantly tabulate and has what appear to be mural pores while these structures are completely lacking in *Cladopora? brownsportensis* and *C.? reticulata*.

The differences mentioned above seem to be of considerable significance and therefore the writer is separating *Cladopora? brownsportensis* and *C.? reticulata* generically from *Coenites verticillata*. For a complete discussion of the relationship of *Cladopora* to *Coenites* see under the *Discussion of Cladopora? brownsportensis*.

The Brownsport specimens of this species are quite similar to Winchell and Marcy's description and figure.

DISTRIBUTION. Winchell and Marcy's specimens came from the Niagaran limestone in the "south part of the city of Chicago, Illinois, in a suburb known as Bridgeport." The writer's specimens came from the Brownsport formation in western Tennessee; this species is also present in the Louisville limestone of Kentucky; for other localities see Bassler (1915, p. 256). There are only two specimens in the collections, which came from location 16-(28), (31).

Genus *Halysites* Fischer von Waldheim, 1913

Halysites catenularia brownsportensis Amsden, n. var.

Plate XVIII, figs. 1-3

DESCRIPTION. This variety is dimorphic and has a corallum consisting of very elongate, cylindrical corallites which are attached to each other along one edge and aligned into rows with the macrocorallites alternating in position with the microcorallites. These rows of individuals wind around and anastomose to form a somewhat massive corallum (pl. XVIII, figs. 1-3). The maximum size attained by the colonies is not known but there is one incomplete specimen which measures 6 inches in diameter and 3 inches thick. The macrocorallites are elongate tubes which are elliptical in cross section, the greatest diameter being about 2 mm. and the lesser 1.5 mm. A continuous wall encloses the macrocorallites and microcorallites and binds them together. Most of the corallites do not show any trace of septa but one macrocorallite was found which has 11 or 12 short septa (pl. XVIII, fig. 2). The macrocorallites possess numerous flat tabulae, 9 or 10 occupying a space of 5 mm. Between each macrocorallite is a microcorallite which has an inside diameter of about two-thirds of a millimeter. These possess closely spaced tabulae which are strongly arched upwards, 22 to 25 occupying a space of 5 mm. (pl. XVIII, fig. 3). Contiguous macrocorallites and microcorallites share a common wall.

DISCUSSION. Linnaeus's description (1767, p. 1270) of *Halysites catenularia* is too brief to be of much value in identification. Since this species was named a great variety of forms have been referred to it but until the specimens studied by Linnaeus are adequately described it will not be possible to determine which are conspecific with the type and which represent new species. For convenience in reference that form of *Halysites "catenularia"* which is found in the Brownsport formation is designated *H. catenularia brownsportensis*.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. This species is not common; collections from the following localities: 16-(28), (31); 11-(36); 38-(90); 47-(85); these collections from the upper 50 feet of the formation.

Genus *Dendropora* Michelin, 1846

Dendropora? culmula Amsden, n. sp.

Plate XX, figs. 1-2

DESCRIPTION. This species has a small dendritic corallum with circular branches which reach a diameter of 5 mm. The corallites open out on all sides of the corallum and have their apertures spaced a considerable distance apart, this intervening distance being occupied by the greatly thickened wall. The apertures are slightly less than a millimeter in diameter and are spaced about 2.5 mm. apart. Around the aperture is an elevated area crossed by about 12 faint grooves which radiate out from the center, the remainder of the surface being granulose. The preservation of the specimens in the collections is such that thin sections do not show the internal structures very clearly. However, the corallites may be seen to arise in the central part of the corallum as rather thin-walled tubes which bend outwards with their walls becoming greatly thickened as they approach the surface. There are numerous round mural pores but no tabulae have been observed.

DISCUSSION. The reference of this species to *Dendropora* is based upon its external resemblance to *D. explicata* (genotype, Michelin, 1846, p. 187, pl. XLVIII, fig. 6) since the internal structure of the genotype was not described by Michelin. *Dendropora? culmula* and *D. explicata* are similar in the size and shape of the corallum but the latter species has more prominent elevations surrounding the apertures. *D. elegantula* (Rominger, 1876, p. 62) is about the same size but has prominent surface ornamentation.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. This species has been found at only two localities, 4-(6) and 39-(91).

Genus *Platyaxum* Davis, 1885

Platyaxum planostiolatum (Foerste)

Plate XX, figs. 6-9

Pachypora (*Platyaxum*) *planostiolata* Foerste, 1909B (p. 106, pl. 3, fig. 55).

Platyaxum planostiolatum (Bassler, 1915, p. 984).

DESCRIPTION. This species has a thin, plate-like corallum which evidently grew as an encrusting mass since no epitheca has been observed on the lower side. There are no complete coralla in the collections but the largest fragment has a maximum diameter of 80 mm. and a maximum thickness of 8 or 9 mm. The corallites are small and vertically compressed so that they are much wider than high; in longitudinal section (pl. XX, fig. 7) they appear as straight tubes whereas in cross-section (pl. XX, fig. 9) they appear as elongate slits or V-shaped openings. They are exceedingly tiny with their height such that 6 or 8 of them occupy a space of 1 mm.; in width they may reach as much as a third of a millimeter. The walls are relatively thick being one and one-half to two times as great as the height of the corallite. They appear to arise in the basal part of the corallum and to continue as fairly straight tubes or slits, approaching the surface of the corallum at an angle of about 20 degrees. At the surface the apertures appear as elongate

slits with the wall of the corallite projecting forward as a semicircular lip and thus giving the surface a scaly appearance (pl. XX, figs. 6, 8). The walls of contiguous corallites appear to be completely amalgamated. No tabulae or septa have been observed.

DISCUSSION. Davis proposed the genus *Platyaxum* and assigned 6 species to it. He figured each of these species but gave no generic or specific descriptions. In 1909 Foerste (p. 103) used the term *Platyaxum* as a subgenus for *Pachypora* and defined the internal as well as the external characters of the genus. Apparently Foerste was unaware that Davis had used the term previously for he states "For this group the term *Platyaxum* is here used." A comparison of the figures of Foerste's species *Platyaxum planostiolatum* with Davis's illustrations of *P. turgidum* (genoelectotype by Lang, Smith and Thomas, 1940, p. 102) indicates that the two are probably congeneric and Bassler (1915, p. 984) so considered them, but until more is known of the structure of *P. turgidum* it is not possible to be absolutely certain that it has the characters described by Foerste.

Foerste based his species *P. planostiolatum* upon material from the Brownsport formation and his descriptions and illustrations agree very well with the specimens in the collections studied.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. This is an uncommon species; collections from the following localities: 11-(36); 36-(105); 51-(69).

Genus *Striatopora* Hall, 1851

Striatopora gwenensis Amsden, n. sp.

Plate XXI, figs. 1-6

Calamopora cristata (Roemer, 1860, p. 20, pl. 2, fig. 12; non *Favosites cristatus* Edwards and Haime, 1851, p. 242).

DESCRIPTION. This species has a dendritic corallum with the basal point of attachment somewhat expanded (pl. XXI, fig. 2). The branches are circular to slightly oval in cross-section, the largest specimen in the collection having a maximum diameter of 13 mm. The corallites arise in the central part of the colony and bend rather sharply outwards, approaching the surface at an angle of about 90 degrees. In the central part of the corallum the walls are thin (pl. XXI, figs. 5, 6) but they thicken rapidly towards the surface so that the corallite apertures are 1.5 to 2 mm. apart (pl. XXI, fig. 4). Near the surface the corallite expands, thus producing a somewhat funnel-shaped aperture; this aperture is 1 to 1.5 mm. in diameter and has its walls marked by 10 to 12 grooves which radiate out from the center. Adjacent corallite walls are not amalgamated and may be easily distinguished from one another. The tabulae are almost flat and spaced about 1 mm. apart as shown in figure 5 of plate XXI; this figure also shows the rather large and rounded mural pores.

DISCUSSION. *S. huronensis* (Rominger, 1876, p. 58, pl. 24, fig. 2) has corallites which are spaced further apart and their apertures are more depressed and more obliquely directed than are those of *S. gwenensis*. *S. gorbyi* (Miller, 1894, p. 261, pl. 8, fig. 1) has the corallites spaced further apart than those of *S. gwenensis* while *S. bella* (Swartz, 1913, p. 215, pl. 25, figs. 1-2) has thinner walls. The Brownsport specimens differ from *S. alba* (Davis, 1885, pl. 64, figs. 9-11) in that the corallite walls are thicker and the apertures less obliquely directed. *S. spiralis* (Ball and

Grove, 1940, p. 393, pl. 3, figs. 1-4, 12) has the corallites apertures spaced much further apart than are those of *S. gwenensis*.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. There are 8 specimens of this species in the collections; these are from the following localities: 7-(11); 9-(3); 18-(2); 11-(36); 39-(118); all from the upper 80 feet of the formation.

Locality 9-(3) is about a mile east of Gwens Landing, Bath Springs quadrangle.

Genus *Planalveolites* Lang and Smith, 1939

Planalveolites louisvillensis? (Davis)

Plate XXI, figs. 7-11

Alveolites louisvillensis Davis, 1885 (pl. 46, figs. 5, 6).

DESCRIPTION. The colony of this species forms very thin encrusting coralla which rarely exceed the thickness of two corallites (pl. XXI, figs. 9, 10). There are only a few fragmentary specimens in the present collection, the largest having a maximum diameter of 20 mm. and a thickness of a little over 1 mm. The corallites arise as prostrate, creeping tubes which bend gradually upwards and intersect the surface of the corallum at an oblique angle (pl. XXI, figs. 10, 11). In the basal part of the colony the corallites are polygonal in cross-section but as they approach the surface they become vertically compressed so that the aperture is somewhat elliptical or even triangular in cross-section (pl. XXI, figs. 9, 11). The corallite apertures are one-half to two-thirds of a millimeter in height and about 1 millimeter wide. The lower wall of each corallite aperture is extended further forward than the upper wall, thus giving the surface the appearance of imbricating scales. Contiguous corallite walls are distinct and there is no thickening of the wall towards the surface. No tabulae, septa or mural pores have been observed.

DISCUSSION. The specimens studied have many of the characters of *Planalveolites*; they have a very thin corallum consisting of almost horizontal corallites with oblique apertures and the lower wall much produced beyond the upper wall. It differs from the genotype *P. foughti* (Edwards and Haime, 1851, p. 257, pl. XVII, figs. 5, 5a) in having much smaller corallites which apparently lack septa and mural pores. Further study of this group of corals may show that a new genus is needed for this type.

The specimens which Davis illustrated are from the Louisville limestone of Kentucky. The Brownsport specimens appear to be quite similar to those which he figured but since he gave no description it is not possible to be certain of the identification. The species which Foerste (1909B, p. 103, pl. 3, fig. 56) identified as *Alveolites inornatus* is more massive, attaining a thickness of 32 mm.

DISTRIBUTION. The specimens studied by Davis are from the Louisville limestone of Kentucky; the writer's collections are from the Brownsport formation of western Tennessee. This is a rare species in the Brownsport; collections from the following localities: 11-(36); 28-(74); 38-(90); 51-(69).

Planalveolites lobelvillensis Amsden, n. sp.

Plate XXXIV, fig. 14

DESCRIPTION. The corallum is thin, encrusting, and composed of rather flat corallites with the apertures obliquely directed. The lower wall of each corallite is projecting, extending beyond the upper. The walls are provided with abundant

mural pores which are relatively large and which do not appear to have any particular arrangement. There is only one fragment of this species in the collection and so the maximum size obtained is unknown. This specimen has a maximum diameter of about 40 mm. and a thickness of about 3 mm. The largest corallites have a maximum diameter of about 3 mm. No septa have been seen.

DISCUSSION. This species is apparently rather similar to *P. foughi* (Edwards and Haime, 1851, p. 257, pl. 17, figs. 5, 5a; Lang and Smith, 1939, p. 154) in the size of its corallites and their oblique apertures; it differs in the lack of any septa. *P. lobelvillensis* is markedly different from *P. louisvillensis*?, having much larger corallites which possess numerous mural pores.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. Only one specimen from locality 38-(90), a short distance north of Lobelville, Tenn.

Genus *Romingerella* Amsden, n. gen.

Plate XXII, figs. 1-6

Genotype *Romingerella major* (*Thecia major* Rominger, 1876, p. 67, pl. XXV, figs. 1, 2).

DESCRIPTION. The corallum is massive, lenticular or encrusting. The corallites arise at the base of the corallum as prostrate creeping tubes which bend abruptly upwards and approach the surface at an angle of about 90 degrees. At the base of the corallum the corallite walls are frequently thin, the thickness being much less than the diameter of the corallite opening. Above this the walls thicken rapidly so that throughout most of the colony the thickness is equal to, or greater than the diameter of the corallite opening. Near the surface of the corallum the mouth of the corallite flares, thus producing a somewhat funnel-shaped aperture. The sides of the apertures are marked by about 12 radiating grooves. Contiguous corallite walls are distinct, the line of junction of adjacent walls being clearly marked in thin section (pl. XXII, figs. 5, 6). This junction of adjacent walls is also marked at the surface by a low but distinct ridge (pl. XXII, fig. 2). The mural pores consist of somewhat irregular, horizontal tubes; where these intersect the surface they produce a deep groove connecting adjacent corallites. There are no vertical tubes penetrating the walls. The tabulae are generally flat, rather thin and irregularly distributed, being numerous in some parts of the corallum and absent in others. There are about 12, somewhat irregular, spinose septa.

DISCUSSION. Corals with the structure described above have been included in the genus *Thecia* but the character of the corallite wall is entirely different. In *Romingerella* the walls of adjacent corallites are distinct and the junction between them may be clearly seen, both in thin section and on the surface, while in *Thecia* the walls are completely amalgamated. Furthermore the walls of *Thecia* possess numerous small vertical tubes, a structure which is not present in *Romingerella*. (See also the Discussion of *Thecia minor*.)

This genus is named for Rominger who carefully described the internal structure of *Romingerella major* (*Thecia major*). This species he believed to be "intimately related" to *Protarea* (Edwards and Haime, 1851, pp. 146, 208). Edwards and Haime's description of this genus is rather brief and lacking in detail but there do appear to be certain important differences between their genus and *Romingerella*. According to these authors the corallites of *Protarea* bear small projections in their angles and also possess a structure resembling a columnella whereas no such structure has been observed in *Romingerella*.

Romingerella major (Rominger)

Plate XXII, figs. 1-6

Thecia major Rominger, 1876 (p. 67, pl. 25, figs. 1, 2).

DESCRIPTION. The specimens in the collections have a corallum in the form of encrusting masses which are very thin in relation to their diameter; the largest specimen measures 13 cm. in diameter and about 15 mm. in thickness. In general the configuration of the upper surface is irregular, being influenced by the object to which the colony was attached. The corallite apertures are funnel-shaped with their sides marked by about 12 grooves. The diameter of the corallite aperture ranges from half to two-thirds of a millimeter and the entire corallite is about 2 mm. in diameter. The internal characters have already been discussed under the description of *Romingerella*.

DISCUSSION. The internal structure of the Brownsport specimens agrees very well with those described by Rominger. They are also quite similar in the size and arrangement of the corallites and in the nature of the apertures. The coralla of the Brownsport specimens are slightly different, being in the form of encrusting masses while at least some of those described by Rominger are discoid and have their base covered with epitheca.

DISTRIBUTION. The specimens figured by Rominger came from Charleston Landing, Indiana, and from Point of Barques on Lake Michigan. This species has also been reported from a number of other localities; see Bassler, 1915, p. 1276. The specimens from this collection are from the Brownsport formation of western Tennessee. It is a common and widespread species and has been collected throughout the formation although it is most common in the upper 40 feet. We have collections from the following localities: 2-(38); 11-(36); 16-(31), (28); 18-(66); 28-(74); 31-(96); 32-(101); 36-(105); 38-(90); 41-(86); 51-(69); 44-(133); 47-(85).

Genus *Thecia* Edwards and Haime, 1849*Thecia minor* Rominger

Plate XXIII, figs. 4-9

Thecia minor Rominger, 1876 (p. 68, pl. 15, fig. 3).*Thecia swinderenana* (Roemer, 1860, p. 26, pl. 2, figs. 4, 4a, 4b; non Goldfuss, 1826, p. 109, pl. 38, figs. 3a, b).

DESCRIPTION. This species has a thin, plate-like corallum with an uneven upper surface. For the most part it grew as an encrusting mass showing no basal epitheca but in a few cases the base of the corallum was partly free and the underside lined with epitheca. The corallites originate at the base of the corallum as prostrate tubes which bend abruptly upwards and approach the surface of the corallum at an angle of about 90 degrees (pl. XXIII, fig. 7). The wall separating adjacent corallites is 1 to 2 mm. thick and is porous. There are two kinds of pores penetrating the wall; the mural pores which are more or less horizontal, tortuous tubes connecting adjacent corallites and a second type which consists of smaller vertical tubes, so tiny that 8 or 10 of them occupy a space of 1 mm. (pl. XXIII, figs. 6-9). The walls of adjacent corallites are amalgamated and thus the corallites appear as vertical tubes set in a porous matrix. The corallites are about a quarter of a milli-

meter in diameter and in cross-section appear as irregular, somewhat star-shaped openings. This shape is due in part to irregular projections of the wall and in part to the mural pores leading away from the openings (pl. XXIII, figs. 6, 9). The corallite apertures are simple openings with only a slight depression surrounding them. A few of the apertures are surrounded by about 12 grooves radiating out from them but most of them appear to lack this ornamentation. The absence of these grooves may be in part due to surface abrasion of the corallum, but since all of the specimens show most of the apertures without them it seems probable that they were not originally developed around all the corallite openings. The surface of the corallum is also broken by winding grooves leading out from the apertures and usually extending to the next corallite opening. These represent the surface expression of the mural pores. The tabulae are thin and flat and irregular in their distribution. They are present to some extent in all parts of the corallum but are most numerous in the basal parts of the colony where 4 or 5 occupy a space of 1 mm. Irregular plate-like or wedge-shaped projections extend into the corallite openings and may represent septa.

DISCUSSION. The genus *Thecia* was proposed by Edwards and Haime (1849, p. 263) but they did not adequately describe the internal characters. In 1876 Rominger (p. 66) gave a description of the genus "*Thecia*," quite clearly basing his study upon the species *Thecia major* (here called *Romingerella major*). Later Nicholson (1879, p. 236) made a careful study of the genotype (*Thecia expatiatus* Lonsdale, 1839, p. 687; Lang, Smith and Thomas state that this is the same as *Agaricia swindernana* Goldfuss, 1829) and noted that there were important differences between the structure of this species and that which Rominger had found. The characters which Nicholson found in *T. expatiatus* are very similar to those which have been noted in the Brownsport specimens of *T. minor* whereas the structure described by Rominger is like that of the specimens of *Romingerella major*. These differences, which have been examined under the discussion of the genus *Romingerella*, appear to be of generic significance. Therefore the species *T. minor* is retained within the genus *Thecia* and a new genus, *Romingerella*, is proposed for those corals with an internal structure like *R. major*.

The specimens of *T. minor* from the Brownsport formation agree well with the description and figures given by Rominger for this species.

DISTRIBUTION. The specimen which Rominger figured came from Louisville, Kentucky; he also found them in the Niagaran strata at Point Detour, Drummond's Island, Lake Michigan, in the drift of the Lower Peninsula and in Indiana. For other localities see Bassler. The writer's specimens are from the Brownsport formation of western Tennessee; it is a common and widespread species which has been found throughout the formation but is most common in the upper 40 feet. The collections are from the following localities: 11-(36); 19-(19); 28-(74); 31-(96); 36-(106), (105); 39-(91), (121), (129); 46-(110), (84); 47-(85).

Genus *Pleurodictyum* Goldfuss, 1829

Pleurodictyum tennesseensis Amsden, n. sp.

Plate XXIII, figs. 1-3

DESCRIPTION. The corallum is somewhat circular in outline with a gently convex upper surface and a convex base which is covered with epitheca. There are only three specimens of this species in the collection, the largest of which measures

23 mm. in diameter and has a maximum thickness of 10 mm. (pl. XXIII, figs. 1-3). This specimen has 7 complete corallites which measure 8 to 10 mm. in diameter and the broken portion of an eighth corallite; the other two specimens are smaller and possess only 5 corallites. The corallites are low and cup-shaped with their height about equal to their diameter. There are 28 to 32 septa present in the form of low ridges. Partial silicification has obscured the wall structure in these specimens and therefore it has not been possible to determine if there are mural pores present or if the walls of adjacent corallites are distinct.

DISCUSSION. This species is similar to *P. trifoliatum* (Dunbar, 1920, p. 118, pl. I, figs. 5-7) but differs in having smaller corallites; also *P. trifoliatum* commonly has 3 corallites in each corallum whereas the Brownsport species has 7 or 8. *P. lenticulare* (Hall, 1874, p. 113; 1887, p. 7, pl. 3, figs. 1-3, 5) is a larger form which has as many as 12 corallites to a corallum. *P. tennesseensis* also lacks the strongly wrinkled basal epitheca and has deeper corallites than does *P. lenticulare*.

P. tennesseensis is apparently the oldest species of *Pleurodictyum* which has been recorded.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. Three specimens have been collected from the following localities: 4-(1); 18-(2); 33-(100).

Genus *Emmonsia* Edwards and Haime, 1851

Emmonsia planobasalis Amsden, n. sp.

Plate XXIV, figs. 1-8

DESCRIPTION. The corallum is hemispherical with a rather strongly convex upper side and a flattened base. It evidently grew with its entire base attached to some object, for the underside shows no trace of epitheca. The corallites radiate out from a central and basal part of the colony as is shown in figures 5 and 6 of plate XXIV. They are polygonal in cross-section with the walls of contiguous corallites not amalgamated (pl. XXIV, fig. 8). There is a considerable variation in the size of the corallites but they average about 2.5 mm. in diameter. The walls are lined with closely spaced spines and irregular scale-like projections which are generally directed towards the aperture (pl. XXIV, figs. 5-8). This squamose structure largely replaces the tabulae although there are a few complete tabulae extending across the corallites as flat plates (pl. XXIV, fig. 6). There are relatively large mural pores present but most of these appear to be filled with secondary material.

DISCUSSION. *E. arbuscula* (Hall, 1876, pl. 36, figs. 1-9; Fenton and Fenton, 1936, p. 34, pl. I, figs. 1-3) differs from *E. planobasalis* in having a somewhat larger, branching or irregularly massive corallum. *E. emmonsi* (Hall) has a much larger corallum and the corallites have numerous well developed mural pores.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. There are only 4 specimens of this species in the collections; from the following localities: 4-(14); 11-(36); 36-(105).

Subclass TETRACORALLA

Genus *Ditoecholasma* Simpson, 1900*Ditoecholasma fanninganum* (Safford)

Plate XXV, figs. 1-7

Petraia fanningana Safford, 1869 (p. 320, pl. 5(H), figs. 32-g).*Ditoecholasma fanninganum* (Simpson, 1900, text figs. 5, 6 on p. 201).

DESCRIPTION. This species has a small, solitary, elongate corallum with the exterior marked by longitudinal grooves, each groove usually marking the position of a septum. The point of basal attachment is restricted and the diameter of the corallum increases only gradually towards the distal end, so that an average specimen has a length of about 25 mm. and a maximum diameter of 7 or 8 mm. The calyx is deep and thin-walled as shown in figure 1 of plate XXV. The septa are simple, thin and generally arranged in pairs so that 2 adjacent septa unite before reaching the center, this septal union taking place at a point ranging from half to three-fourths the distance from periphery to center; after uniting they continue on to the center as a single septum. A few of the septa are not paired but extend to the center as a simple septum. The septa are united at the center to form a pseudocolumnella as shown in figures 4-7 of plate XXV. At the distal end of an adult specimen there are 28 to 32 septa on the outer periphery. Tabulae are present in the form of thin, arched plates which vary somewhat in their spacing but average slightly less than a millimeter apart (pl. XXV, fig. 5). Most of the tabulae are complete, extending from the periphery inwards to unite with the pseudocolumnella, but a few are incomplete, dissepiment-like plates.

DISCUSSION. The pseudocolumnella of *Ditoecholasma* is similar to that of *Enterolasma* but *Ditoecholasma* differs in having thin, non-carinate septa which are usually paired.

DISTRIBUTION. Silurian, Brownsport formation of west Tennessee. This is a very common and widely distributed species which is found throughout the formation; specimens from the following localities and horizons: 4-(6), (14); 19-(19); 11-(36); 26-(79); 27-(119); 29-(71), (77), (93); 36-(106); 39-(73), (91), (103), (118), (121), (129); 40-(104), (123); 44-(133).

Ditoecholasma acutiannulatum Amsden, n. sp.

Plate XXV, figs. 8-10

DESCRIPTION. There are only two specimens of this species in the collection, the largest measuring 25 mm. long and about 10 mm. at its maximum diameter. The lower part of the corallum is cone-shaped but it becomes cylindrical in the upper portion. The surface is marked with prominent, sharp-edged annulations spaced about 5 mm. apart (pl. XXV, fig. 9). In addition there are longitudinal grooves on the outside of the corallum, each groove marking the position of a septum. The septa are usually arranged in pairs, two adjacent septa uniting before reaching the center and then continuing as a single septum to the axis where they unite to form a pseudocolumnella. In a few cases the septa are not united into pairs, a single septa extending to the center by itself. Between each of these major septa there is usually a very low minor septa which is represented in some cases by only a slight thickening of the wall (pl. XXV, fig. 10). There are a few tabulae

present as thin, arched plates which extend from the periphery to the pseudocolumnella (pl. XXV, fig. 8). The calyx is not preserved on either of the specimens.

DISCUSSION. Externally this species differs from *D. fanninganum* in its prominent annulations. Internally the septal arrangement and pseudocolumnella are quite similar to those of *D. fanninganum*. *D. acutiannulatum* differs in having a second set of very low septa alternating in position with the major septa, and not as many or as closely spaced tabulae.

The corallum of *D. acutiannulatum* is similar to that in immature specimens of *Cyathophyllum cliftonense* (compare with fig. 4 on pl. XXVIII) and it is usually necessary to make sections to be certain of the identification.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. There are two specimens from localities 11-(36) and 28-(74).

Genus *Enterolasma* Simpson, 1900

Enterolasma waynense (Safford)

Plate XXV, figs. 11-16

Petraia waynense Safford, 1869 (pp. 314, 320, pl. 5(H), figs. 2a-h).

Enterolasma waynense (Simpson, 1900, p. 204; text figs. 13-15).

DESCRIPTION. This species has a solitary, cone-shaped corallum which is straight to slightly curved. The largest specimen in the collection measures 30 mm. long, and 12 mm. at point of maximum diameter. It has a deep calyx as shown in figures 11 and 13 of plate XXV. The surface of the corallum is marked by longitudinal grooves which mark the position of the septa; in addition there are a few transverse rugae. The septa are of two sizes, the smaller extending from one-third to one-half the distance from periphery to axis, and alternating in position with the longer ones which extend to the axis and unite to form a pseudocolumnella (pl. XXV, figs. 14-16). In some cases two of the larger septa unite just before reaching the axis. Both the large and the small septa bear short carinae on their sides. In some places there may be a deposition of secondary material between the septa to form a zone of stereoplasm as shown in figure 14 of plate XXV. Tabulae are thick, convex downward and extend from the periphery to the pseudocolumnella; they are closely spaced, about 10 occupying a space of 5 mm. Both the tabulae and septa, as well as the outer wall, are relatively thick for a species of this size (cf. *Ditoecholasma fanninganum* and *D. acutiannulatum*).

DISCUSSION. Both Safford's and Simpson's specimens came from the Brownsport formation and their description and figures agree very well with the specimens in the present collections. Simpson figured a thin section of one specimen (1900, text fig. xv) showing an inner zone of stereoplasm which he interpreted as representing a second individual growing from the calyx of the first. The writer has seen a similar instance of a zone of stereoplasm (pl. XXV, fig. 14) but this is interpreted as secondary deposition within the same individual, since the septa may clearly be seen to extend from the periphery through the stereoplasm to the axis. This probably represents a restriction in the size of the individual and very likely correlates with the external rugae which commonly mark the sides of the corallum.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. The writer has also identified this species from the Henryhouse formation of Oklahoma and Ball and Grove (1940, p. 383) record it from the Bainbridge of Missouri.

This is an exceedingly common species in the Brownsport and has been found

throughout the formation; collections from the following localities: 4-(6), (14), (44); 13-(41); 17-(24); 18-(2), (13); 19-(19); 22-(15); 26-(81), (79); 27-(75), (119); 28-(74); 29-(72), (77), (93), (71); 32-(107); 33-(100); 34-(117); 35-(98); 36-(105); 39-(91), (73), (103), (121), (129); 40-(104), (123); 42-(93); 44-(133); 46-(84); 47-(85); 49-(109), (132).

Genus *Anisophyllum* Edwards and Haime, 1850

Anisophyllum agassizi Edwards and Haime

Plate XXV, figs. 17-20

Anisophyllum agassizi Edwards and Haime, 1851 (p. 351, pl. 1, figs. 2, 2a).

DESCRIPTION. This species has a small, cone-shaped, solitary corallum with the exterior longitudinally striated and with a few obscure, transverse wrinkles. In most individuals the corallum is fairly straight but in a few specimens it is slightly curved. A specimen of average size will measure about 25 mm. long and 10 or 12 mm. in diameter at the lip of the calyx; the largest corallum in our collections is 30 mm. long and 13 mm. wide. The calyx is slightly oblique and very deep, the depth in a mature individual being about one-half the total height of the corallum. There are about 32 septa present on the upper lip of the calyx wall, 3 of these prominent and the rest represented by low ridges. These small, low septa appear to be paired for as they progress down into the calyx the 2 adjacent ones usually unite to form one septa which is slightly larger. The 3 prominent septa are considerably elevated above the others, very thick, and extend to the center where they unite to form a structure resembling a columnella. There is a deep fossula opposite the center one of these three rays. The nature of the calyx and the arrangement of these three septa are well shown in figures 17-19 of plate XXV. Unfortunately, all the specimens in the collections are partly silicified and therefore it has not been possible to obtain any satisfactory thin sections. This has prevented us from studying the internal characters of the species.

DISCUSSION. Edwards and Haime based their description of this species upon specimens from Perry County, Tennessee. These specimens quite evidently came from the Brownsport formation since there are a considerable number of specimens in the present Brownsport collections which appear identical to those described by these authors.

DISTRIBUTION. Silurian, Brownsport of western Tennessee. This is a fairly common species in the Brownsport formation and collections have been made from the following localities: 4-(1), (14); 9-(3); 16-(28); 18-(2), (13); 19-(61); 24-(12); 33-(100); these collections from the lower 60 feet of the formation.

Genus *Arachnophyllum* Dana, 1846

Arachnophyllum pentagonum (Goldfuss)

Plate XXVI, figs. 1-6

Strombodes pentagonus Goldfuss, 1826 (p. 62, pl. 21, figs. 3a-b).

DESCRIPTION. This species has a compound, plocoid corallum which forms large, flattened, plate-like expansions. The maximum size attained by this species is not known but there is an incomplete corallum in the collections which reaches a maximum diameter of 25 cm. and a maximum thickness of 5 cm. The base is

covered by epitheca with the position of each corallite usually marked on the lower side by a conical mound. Most of the corallites are pentagonal in outline and have a maximum diameter of about 20 mm. They are packed closely together with the junction of adjacent corallites marked on the surface by a low ridge. The calicular pit is rather shallow and 4 or 5 mm. in diameter; surrounding this depression is a low mound which is in turn surrounded by a shallow valley separating it from the outer ridge (pl. XXVI, fig. 1). There are 22 to 25 septa within the calicular pit, some of which extend to the center and unite to form a calicular boss (pl. XXVI, figs. 2, 5). There are only a few dissepiments within this calicular pit represented by plates lying between the septa but the surrounding peripheral zone is largely filled with successive layers of dissepiments. The septa in this outer zone become partly degenerate and are represented as vertical plates or crests resting upon the dissepimental floor (pl. XXVI, figs. 3, 4, 5). In this outer zone there are transverse, vertical plates between the septal crests, thus producing a cellular structure (pl. XXVI, figs. 2, 5).

DISCUSSION. The genus *Arachnophyllum* was proposed by Dana in 1846 (p. 186) and was restudied in 1927 by Lang and Smith (p. 242) who gave a careful description of the internal characters. The relationship of *Arachnophyllum* to *Strombodes* was discussed by Lang, Smith and Thomas in 1940 (p. 126).

The Louisville specimens which Davis identified as *Strombodes* (*Arachnophyllum*) *pentagonum* (1885, pl. 121, figs. 2, 3) and *Strombodes* (*Arachnophyllum*) *incertus* (1885, pl. 123, fig. 2) appear to be very similar to each other and both resemble the Brownsport forms. In the absence of any description it is difficult to determine what features Davis used to separate the two.

DISTRIBUTION. Goldfuss's specimens came from the Niagaran of Drummond's Island, Lake Michigan. The present collection came from the Brownsport formation of western Tennessee; it is also present in the Louisville limestone, Kentucky; for other localities see Bassler (1915, p. 1221) and Shimer and Shrock (1940, p. 101).

This is not a common species in the Brownsport formation; it has been found at only 2 localities, 11-(36) and 16-(31), where it occurs in the upper 50 feet of the formation.

Genus *Entelophyllum* Wedekind, 1927

(Synonym, *Xylodes* Lang and Smith, 1927)

Entelophyllum rugosum (Smith)

Plate XXVII, figs. 1-6

Xylodes rugosus Smith, 1933 (p. 516, pl. 1, figs. 6-11; non *Eridophyllum*? *rugosum* Edwards and Haime, 1851, p. 424, pl. 10, figs. 4-4b).

DESCRIPTION. This species has a compound, phaceloid corallum consisting of elongate, cylindrical corallites which are in contact with one another throughout most of their length. There is one corallum in the collection which is roughly hemispherical and which measures about 15 cm. wide and 10 cm. high; all the other specimens are only small fragments and therefore do not give a good idea of the general shape assumed by the corallum. The sides of the corallites pinch and swell thus producing a transverse annulation; in addition to this annulation the sides are marked with faint longitudinal grooves. The corallites are attached to one another by obliquely directed spiniform processes as shown in figures 1 and

3 of plate XXVII. A few of the corallites attain a diameter of 12 mm. but the average is slightly less than 10 mm. An adult corallite has a total of about 50 major and minor septa present on the outer periphery. The major septa are long and extend almost to the axis, being free at their inner ends. For about half their length they are moderately thick, having about the same size as the minor septa; beyond this they become much thinner. These major septa alternate in position with the minor septa which extend about half the distance from periphery to axis and which are also free on their inner ends (pl. XXVII, figs. 2, 3). The corallites are divided into a well marked dissepimentarium and tabularium with the latter occupying the central half of the corallite. On the outer periphery of the dissepimentarium the dissepiments are rather large and widely spaced; inside of this there is a zone in which the dissepiments are much smaller and more closely packed. The tabulae are thin plates which are convex upwards, spaced so close together that about 5 of them occupy a space of 1 mm.; both complete and incomplete tabulae present.

DISCUSSION. In 1933 Smith (p. 512) made a careful study of American forms which have commonly been referred to *Eridophyllum rugosum* (Edwards and Haime) and noted that they were neither conspecific with *Eridophyllum rugosum* nor congeneric with *Eridophyllum verneuianum* (genotype of *Eridophyllum*). He found that they represented a new species belonging to the genus *Xylodes* (this genus has subsequently been shown to be a synonym of *Entelophyllum*; see Smith and Tremberth, 1929, p. 362, and Lang, Smith and Thomas, 1940, p. 58). For this new species he proposed the name *Xylodes* (*Entelophyllum*) *rugosum*, basing his description and illustrations upon specimens from the Louisville limestone of Kentucky. The specimens from the Brownsport agree very well with his descriptions and illustrations.

DISTRIBUTION. Smith's specimens came from the Louisville limestone. The present collection is from the Brownsport formation; at least some of the American forms identified as *Eridophyllum rugosum* (Bassler, 1915, p. 494) are conspecific with *Entelophyllum rugosum* (see Shimer and Shrock, 1944, p. 99).

This is not a common species in the Brownsport formation; collections from the following localities: 16-(28), (31); 19-(19); 11-(36); 38-(90).

Genus *Amplexus* Sowerby, 1814

Amplexus brownsportensis Amsden, n. sp.

Plate XXVII, figs. 7-13

?*Cyathophyllum radicola* (Davis, 1885, pl. 86, figs. 1-6; non Rominger, 1876, p. 109, pl. 39, fig. 3).

DESCRIPTION. This species has a solitary corallum which is cylindrical throughout most of its length with only the basal part restricted. The diameter varies due to numerous expansions and contractions which produce a transversely annulated exterior, about 4 annulations occupying a space of 5 mm. In addition to these transverse wrinkles the exterior is marked by longitudinal grooves. There are bends in the corallum, some of these flexures being almost at right angles to the previous direction of growth. The specimens show a good deal of variation in the size of the corallum with an average size of perhaps 12 mm. wide and 30 mm. long; one of the largest coralla has a diameter of 20 mm., and a length of 40 mm. The calyx is moderately deep and has a fossula as shown in figure 7 of plate

XXVII. There are 50 to 60 septa present on the outer periphery of an adult specimen. These septa extend approximately half the distance from periphery to axis and are thick on their outer edges, thinning gradually to a point on their inner ends and thus appearing somewhat wedge-shaped in cross-section (pl. XXVII, fig. 10). The septa are spinose on their inner edges as shown in figure 13 of the plate XXVII. The tabulae are fairly flat with about 5 of them occupying a space of 5 mm.; they are confined to the central part of the corallum in the adult stages (pl. XXVII, fig. 13). There are no dissepiments present.

DISCUSSION. Internally this species is characterized by its serrate septa which do not extend to the center and by its well developed tabulae. Such characters are generally considered as characteristic of the genus *Amplexus* although it should be noted that no detailed description of the genotype *Amplexus coralloides* (Sowerby, 1814, p. 196, pl. lxxii, figs. 1, 2) has been seen.

Rominger did not give any detailed description of the internal structure of his species *Cyathophyllum radícula* (1876, p. 109, pl. 39, fig. 3) and therefore it is not possible to be certain whether this species should be referred to *Cyathophyllum* or to *Amplexus*. Externally some of the specimens which he illustrates are similar to *A. brownsportensis* while others are quite different. The left and center rows of specimens in his figure 3 appear to be smaller and to have the annulations spaced further apart than in the Brownsport species, while the right-hand row is more similar to the writer's specimens. Rominger stated that this right-hand row might represent a new species but until more is known of the internal structure of his species it is not possible to state whether they are in part conspecific with *A. brownsportensis*.

Davis's illustrations of *Cyathophyllum radícula* from the Louisville limestone have an external form which is quite similar to *A. brownsportensis* but in the absence of any description it is not possible to make a definite correlation.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee; possibly present in the Louisville limestone of Kentucky. This is a common coral in the Brownsport and has been collected throughout the formation. There are collections from the following localities: 4-(1), (9), (44); 17-(24); 18-(2), (13); 19-(19); 23-(21), (64); 25-(4); 28-(74); 38-(90); 49-(109).

Amplexus shumardi (Edwards and Haime)

Cyathophyllum shumardi Edwards and Haime, 1851 (p. 370, pl. 7, fig. 3).

DESCRIPTION. This species has a cylindrical, elongate, solitary corallum with widely-spaced, prominent expansions and contractions. The space between the expansions varies from 5 to 20 mm., the average being about 10 mm.; in addition to this the surface also has very fine, transverse striations, about 10 of these occupying a space of 5 mm. There are well developed, longitudinal grooves on the outside of the corallum, each groove marking the position of a septum. The size of the corallum is variable; there are small specimens which have a diameter ranging from 10 mm. at the restricted portion to 15 mm. at the expansions; the largest specimens have a diameter ranging from 15 to 20 mm. The maximum length attained by this coral is not known since all the specimens are incomplete; the longest fragment in the collection is 40 mm. There are about 60 septa on the outer periphery of an adult specimen. These septa are divided into 2 ranks with the smaller extending inwards for about one and a half millimeters. The larger septa alternate in position with the smaller septa and extend inwards for about

three-fourths of the distance from periphery to axis; both the major and minor septa are free on their inner ends and both possess carinae on their sides. The tabulae are flat to slightly arched plates located in the central part of the corallum and spaced from 1 to 3 mm. apart.

DISCUSSION. Edwards and Haime based their description of *A. shumardi* upon specimens from the Brownsport formation of Perry County, Tennessee. The specimens in the present collections agree with their description and illustration. The specimens which Davis figured as *A. shumardi* (1885, pl. 132, fig. 14; *Amplexus davisii* (?) Foerste, 1931, pl. XXV, fig. 2) appear to have much more widely spaced expansions.

This species differs from *A. brownsportensis* in its larger size and in its more widely spaced expansions. The general internal structure of these two species is similar but differs in that *A. shumardi* has carinate septa which appear to lack serrations on their inner edges.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee; for other localities from which this species has been reported see Bassler (1915, p. 40) and Shimer and Shrock (1944, p. 93).

This is a moderately common species in the Brownsport formation; collections from the following localities: 18-(2), (13); 28-(74); 38-(90); 51-(69); it is quite abundant at localities 28 and 38.

Genus *Cyathophyllum* Goldfuss, 1826

Cyathophyllum cliftonense Amsden, n. sp.

Plate XXVIII, figs. 1-8

DESCRIPTION. This species has an elongate, solitary corallum which is cylindrical throughout most of its length with only the base restricted (pl. XXVIII, fig. 3). The corallum has numerous, sharp-edged expansions which are spaced from 5 to 10 mm. apart and which extend out beyond the restricted portion for a distance of 2 or 3 mm. (figs. 1-4, pl. XXVIII). The theca is marked with fine, transverse striations, 4 or 5 of these occupying a space of 1 mm.; in addition to these striations there are rather faint longitudinal grooves. The specimens vary a good deal in the size of the corallum, the diameter ranging from 12 to 20 mm. and the length ranging up to 35 mm. The calyx is deep and flares at the distal end as shown in figure 4 of plate XXVIII; no fossula has been observed. There are about 50 septa located on the outer periphery of an adult specimen and these extend inwards for about half to three-fourths of the distance to the axis. In passing through the dissepimentarium the septa may be somewhat irregular with its course deflected by the dissepiments, or in a few cases it may be completely interrupted (pl. XXVIII, fig. 8). In many places a short septa intervenes between two of the major septa; these short septa are usually incomplete and many of them are present only on the inner wall of the dissepimentarium. There is a well marked tabularium and dissepimentarium with the latter rather narrow and occupying the outer periphery (pl. XXVIII, figs. 5, 7). The thickness of the dissepimentarium is to some extent dependent upon the diameter of the corallite, it being thickest where the diameter is greatest; an individual with a diameter of about 12 mm. has the dissepimentarium extending inwards for only a millimeter and a half. The dissepiments are numerous, small and packed close together. In the central tabularium the tabulae consist of thin, flat to slightly arched plates which vary greatly in their

spacing but average about a millimeter apart. Most of the tabulae are complete but there are a few which do not extend completely across the tabularium.

DISCUSSION. No detailed description of the internal characters of *Cyathophyllum dianthus* (genoelectotype, Goldfuss, 1826, p. 54, pl. 15, figs. 1a-e) has been seen and therefore the reference of the species to this genus is not absolutely certain. *Cyathophyllum* has been considered by most authors to have a well developed dissepimentarium and tabularium, and septa which extend to the center and unite. The last mentioned character is not possessed by *C. cliftonensis* and in this respect it is similar to the adult stages of *Caninia* (Michelin in Gervais, 1840, p. 485; Caruthers, 1908, pp. 158-170) but in *Caninia cornucopiae* (genotype) the dissepimentarium is very thin and confined to the upper part of the corallum. *Campophyllum* has a more highly developed dissepimentarium but it is now considered to be synonym of *Caninia* (Lang, Smith and Thomas, 1940, p. 30). It seems best to refer this Brownsport species to the genus *Cyathophyllum* since this is where most Silurian species with this type of structure are placed, but further study of the genus *Cyathophyllum* may well show that *C. cliftonensis* should be referred elsewhere.

The external characters of this species are somewhat similar to those of *Amplexus brownsportensis* but the corallum of the latter tends to be slightly larger and to have the expansions spaced further apart. The internal structure differs in that *C. cliftonense* has a well defined dissepimentarium.

Amplexus cinctutus (Miller, 1894, p. 259, pl. 1, figs. 5, 6) has a corallum which is similar to *C. cliftonense* in having broad, sharp-edged expansions but differs in being much larger than the Brownsport species.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. This is a common species which is rather widely distributed; collections from the following localities: 2-(38); 11-(36); 26-(81); 28-(74); 36-(105), (106); 38-(90); 47-(85); 51-(69). This species probably ranges throughout the formation.

Cyathophyllum angulare Amsden, n. sp.

Plate XXVIII, figs. 9-15

DESCRIPTION. This species has a cylindrical corallum with numerous small expansions and contractions which give the exterior an annulated appearance. In addition to these annulations there are fine transverse striations and rather faint, longitudinal grooves. The corallum commonly shows sharp bends some of which almost reverse the direction of growth (pl. XXVIII, figs. 9-11). Most of the specimens in the collections have a rather thin and elongate corallum, the longest being 35 mm. and having a maximum diameter of 7 mm. The calyx is moderately deep and does not flare greatly (pl. XXVIII, fig. 12); no fossula observed. There are about 50 septa present on the periphery of an adult corallite. They are relatively thick for a species of this size and extend inwards for about three-fourths of the radius of the corallite, being free at their inner ends. There is a tendency for some of the septa to be paired, with two adjacent septa uniting at about mid-length and then continuing on as a single septum. There is a well defined tabularium and dissepimentarium, the latter being quite thick and occupying the outer half or two-thirds of the corallite. The dissepiments are small and closely spaced. There are both complete and incomplete tabulae present as shown in figures 13 and 15 of plate XXVIII; they are closely spaced, about 12 occupying a space of

5 mm. The walls of the tabulae and dissepiments are quite thick for a species of this size (compare with *C. cliftonense*).

DISCUSSION. *C. angulare* has a smaller corallum than *C. cliftonense* and lacks the prominent, sharp-edged expansions of the latter. The internal structure of the two is similar although the dissepimentarium of *C. angulare* occupies a greater proportion of the corallite.

The external form of *C. angulare* is similar to that of *Amplexus brownsportensis*. Both species have annulated coralla which frequently show abrupt changes in the direction of growth, but *A. brownsportensis* is larger and has more prominent annulations. The internal structure of these species is very different (compare pl. XXVII, figs. 10, 13 with pl. XXVIII, figs. 13-15).

C. hydraulicum (Simpson MS.; Grabu, 1900, p. 364, pl. 21, figs. 1a-d) is a slightly larger species with the septa extending to the center of the corallite where they are united.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee; collections from the following localities and horizons: 4-(1), (6), (9), (44); 26-(81); 38-(90); 47-(85); this is a rare species except at locality 38 where it is abundant.

Cyathophyllum pegramense (Foerste)

Plate XXXIV, figs. 5-7, 11, 12

Heliophyllum pegramensis Foerste (1909B, p. 100, pl. 3, figs. 58A, 58B).

DESCRIPTION. This species has a low corallum which tends to be cone-shaped although it shows some variation. It is commonly curved and some specimens show angular bends in the direction of growth. The surface is marked with low, transverse annulations and longitudinal striations. The calyx is rather deep and tends to flare towards the upper end. Internally it is similar to *C. cliftonense*, having a well marked tabularium and dissepimentarium. It differs in that the septa extend to the center and twist, forming a pseudocolumella; also the dissepimentarium is better developed in *C. pegramense*, occupying about half of the diameter of the corallum. Specimens with a diameter of about 25 mm. have from 70 to 80 septa. There are a large number of specimens of this species in the collections, none of which exceed a length of 40 mm. A specimen of average size measures 30 mm. long, 25 mm. wide at the maximum diameter and has a calyx about 10 mm. deep.

DISCUSSION. Foerste referred this species to the genus *Heliophyllum* but he does not mention any vertical carinae on the septa nor do thin sections show this. With the exception of the pseudocolumella it appears to have an internal structure much like that of *C. cliftonense* and *C. angulare* and it therefore seems best to refer it to *Cyathophyllum* (see Discussion under *C. cliftonense*). Some of our specimens are larger than Foerste's but otherwise appear to be the same.

DISTRIBUTION. Foerste's specimens came from the Brownsport formation of western Tennessee; the writer's specimens also came from the Brownsport and were collected at the following localities: 11-(36); 28-(74); 32-(101); 38-(90); 41-(86); 51-(69).

Genus *Rhizophyllum* Lindström, 1866A*Rhizophyllum tennesseense* (Roemer)

Plate XXIX, figs. 1-5

Calceola tennesseensis Roemer (1854, p. 385; 1860, p. 73, pl. 5, figs. 1a-e).*Calceola* (*Rhizophyllum*) *tennesseensis* (Bassler, 1915, p. 157).

DESCRIPTION. This species has a solitary corallum which is in the shape of a cone with one side strongly flattened. The corallum is arched with the basal tip often hooked and the calyx aperture opens obliquely. That side of the corallite which is convexly arched is flattened as may be seen in figure 5 of plate XXIX. The theca is marked with transverse striations which are most prominent on the flattened side. The largest specimen in the collection is 23 mm. high, 28 mm. wide and 15 mm. deep; a specimen of average size is shown in figure 3 of plate XXIX. The basal tip of all the specimens is broken, this broken end probably indicating the initial point of attachment. This broken end is not over a millimeter across and since none of the specimens show any rootlets or other means of support it seems most unlikely that the corallite could have remained in an upright position during the adult stage. The polyp probably started its growth attached by the base to some object and then at a later stage toppled over onto the flattened side where it remained for the rest of its life.

The calyx narrows rapidly as it progresses downward and is thus funnel-shaped with the deeper portion somewhat slit-like and extending about three-fourths of the distance from the top to the bottom of the corallum. The shape and arrangement of the calyx are well shown in figures 1, 3, 4 of plate XXIX. The back or flattened side of the calyx is marked by septal ridges but the other sides remain completely smooth. The center septum on this flattened side is elevated above the others and much thickened; it is flanked on each side by 9 to 12 much smaller septal ridges. These septa disappear as they progress down into the calyx, this disappearance being apparently due to the wall's thickening and burying the septa. Evidently as the polyp grew larger it covered the septal ridges in the lower part of the corallum by a secondary deposit.

This species has an operculum which is hinged on the side that is in contact with the back or flattened side of the calyx. The side of the operculum which is hinged has a series of grooves which correspond to the septa on the calyx wall, thus making a secure and efficient hinge. The operculum is marked with concentric lines indicating successive growth stages (pl. XXIX, fig. 2).

That part of the corallum which is not occupied by the calyx is filled with dissepiments whose size and arrangement are well shown in figures 4 and 5 of plate XXIX.

DISCUSSION. Lindström (1866A, p. 287; 1866B, pp. 359, 411) described the genus *Rhizophyllum*, the genotype being *Calceola gotlandica* (Roemer, 1856, p. 798). This genus was distinguished from *Goniophyllum* (Edwards and Haime, 1850, p. lxix) and *Calceola* (Lamarck, 1799, p. 89) by its cystose structure, the presence of rootlets and more weakly defined septa. On the basis of the close similarity between *Rhizophyllum tennesseense* and *R. gotlandicum* in the general shape of the corallite, nature of the septa and cystose structure it seems to the writer that the Brownsport species should be placed in the genus *Rhizophyllum* rather than in *Calceola*. Furthermore the differences between *Rhizophyllum* and *Calceola* appear to be of generic rather than subgeneric rank.

The operculum of this species is rarely found, for out of about 30 specimens in the collections, only one had this structure and it was partly crushed (fig. 2, pl. XXIX).

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. This is not a common species and has been found in only the lower 40 feet of the formation; collections from the following localities: 4-(14); 18-(2); 19-(19); 20-(22); 29-(93); 36-(105); 39-(91); 44-(133); 51-(69); 53.

Genus *Cystiphyllum* Lonsdale, 1839

Cystiphyllum lineatum? Davis

Plate XXIX, figs. 6-11

Cystiphyllum lineatum Davis, 1885 (pl. 128, figs. 1-4).

DESCRIPTION. The specimens of this species show a good deal of variation in their size and shape. In general it has a cone-shaped corallum with some individuals tending to flare rather widely at the distal end. The theca is concentrically wrinkled and has longitudinal grooves (pl. XXIX, figs. 6, 7, 11). The largest specimen in the collection (pl. XXIX, fig. 7) measures 50 mm. high and about 60 mm. in diameter at the distal end; the specimen shown in figures 6, 11 of plate XXIX is about average in size and measures 25 mm. high and 28 mm. wide. It has a bowl-shaped calyx which is fairly deep, the depth on an adult ranging from a fourth to a half of the total height of the corallum. Several of the specimens show rather faint septal grooves which appear to be confined to the upper walls of the calyx. The calyx shown in figure 8 of plate XXIX does not show any trace of septa but this may be due to surface abrasion. The corallum is completely filled with dissepiments whose size and arrangement are shown in figures 9, 10 of plate XXIX.

DISCUSSION. The specimens in the collections resemble those illustrated by Davis but in the absence of any description it is not possible to be certain of this identification.

DISTRIBUTION. Davis states that he has specimens from both the Lower Devonian and the Niagaran beds in the vicinity of Louisville but Bassler (1915, p. 372) refers to the stratigraphic horizon as Niagaran (Louisville) only.

The present specimens come from the Brownsport formation of western Tennessee. There are about a dozen specimens of this species from localities 11-(36) and 38-(90); these were collected in the upper 50 feet of the formation.

Genus *Ptychophyllum* Edwards and Haime, 1850

Ptychophyllum? *cliftonense* Amsden, n. sp.

Plate XXX, figs. 1-7

DESCRIPTION. This species has a large, solitary corallum which is cone-shaped in the lower part, becoming cylindrical in the upper part; the cylindrical portion is somewhat compressed so that it is oval in cross-section. The corallum is in the form of a series of invaginated cups, the lip of each successive cup being represented by an expansion on the side of the corallite. The basal, cone-shaped portion of the corallum is usually free of such expansions but they become quite numerous in the upper part and often give the corallum a ragged appearance (pl. XXX, fig. 1). These expansions are irregularly distributed, the distance between them ranging from a millimeter or so up to 10 mm. None of the specimens are complete

and therefore it is impossible to give very accurate dimensions; the specimen shown in figure 3 of plate XXX is the best preserved one and it has a length of 80 mm. (basal portion incomplete), a maximum long diameter of 40 mm. and a short diameter of 30 mm. There is one much abraded fragment with a length of 13 cm. which appears to belong to this species.

The calyx probably does not exceed a depth of 5 or 6 mm. and has a low pseudocolumnella in the center where the septa unite (pl. XXX, fig. 2).

There are about 100 major and minor septa present in the upper part of a mature corallum. The major septa extend to the center of the corallum where they are twisted together to form a large pseudocolumnella or axial vortex (pl. XXX, figs. 4, 7). In the upper parts of the corallum there is a deposition of stereoplasm in the area where the septa are united but this is absent in the immature portions. The minor septa alternate in position with the major septa and extend about half the distance from periphery to axis; in the basal parts of the corallum all the septa extend to the center (pl. XXX, fig. 7).

The successive positions of the wall of the calyx (invaginated cups mentioned above) are represented in cross-section by concentric zones of stereoplasm (pl. XXX, fig. 4). In some places the septa pass through these zones without interruption, the stereoplasm appearing as a secondary filling between the septa; in other places the septa do not extend inwards from one zone to the next but are interrupted and a new septum begins on the inner edge of the next stereoplasm zone. The walls of the septa are covered with small nodes or spines (pl. XXX, fig. 4, 5). There are dissepiments lying between the septa which are strongly arched in the outer part of the corallum but become flat (tabellae) towards the center. There are no tabulae present.

DISCUSSION. There is some question regarding the generic position of this species but it is being placed in the genus *Ptychophyllum* since it has some of the internal characters of that genus. The Brownsport specimens are similar to *P. stokesi* (genotype, Edwards and Haime, 1850, p. lxix; Lang, 1926B, text fig. 2, nos. 1 and 2, p. 431) in that the major septa extend to the center and unite in a twist; also the septa are somewhat discontinuous and are united by dissepiments. *P. cliftonense* differs in that the central zone formed by the union of the septa is much larger than that shown in *P. stokesi*; furthermore, there is a good deal of stereoplasm present in this species which does not appear to be present in *P. stokesi*.

P. invaginatum (Davis, 1885, pl. 105, figs. 9, 10) is a smaller and more conical shaped species than is *P. cliftonense*. Foerste's species *P. vulcanius* (1903, p. 713) is smaller and has a very broad cup.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. There are about a dozen specimens which were collected at locality 16-(31), (28).

Genus *Naos* Lang, 1926A

Naos sewellensis Amsden, n. sp.

Plate XXXII, figs. 1-6; plate XXXIII, figs. 1-9

DESCRIPTION. This species has a solitary corallum which is usually cylindrical throughout most of its length with only the basal part restricted, but a few individuals do continue to expand slightly throughout the corallum (pl. XXXII, figs. 2). The outside of the corallum is marked with rather evenly-spaced, low, rounded annulations, ranging from 3 to 5 mm. apart. In addition to these annulations there are small, longitudinal ridges on the outside which mark the position of the septa.

The calyx is moderately deep and the diameter of the inner cup is equal to about one-half of the diameter of the entire corallum. The walls of the calyx flare outwards and are marked with septal ridges as shown in figure 5, plate XXXIII; in large individuals the outermost lip of the calyx may be bent downwards (pl. XXXII, fig. 3). The specimen shown in figure 1 of plate XXXII is the largest in the collection, measuring 50 mm. long and 30 mm. in diameter; figures 1, 2 and 4 of plate XXXIII show individuals which are about average in size.

The septa extend inwards almost to the center of the corallum and are usually free at their inner ends although in some places adjacent septa unite. There are 40 to 45 septa in this central area all of which possess straight, well developed walls (pl. XXXII, figs. 5, 6; pl. XXXIII, fig. 6). As the septa progress outwards each of them divides and forms two, so that in the outer part of the corallum there are 80 to 90 septa. Beyond the point where the septa divide, the walls become a trifle thicker and less well defined and a short distance further out they begin to assume a zigzag course with small protuberances extending beyond the bends (pl. XXXII, fig. 5). Near the periphery the septa tend to become discontinuous; a tangential section near the outer periphery shows that in part the septa are represented by crests on the dissepiments (pl. XXXIII, fig. 7).

The corallum is divided into a well marked tabularium and dissepimentarium with the latter occupying the outer half of the corallum (pl. XXXII, fig. 4; pl. XXXIII, fig. 3, 8). The dissepiments are small, closely-spaced, convex plates arranged in rows. Near the tabularium these rows are inclined upwards but as they progress outwards they tend to become horizontal and in large coralla they may even be inclined downwards. These dissepimental rows reflect successive positions occupied by the calyx lip. When the dissepiments are seen in a cross-section they appear as V-shaped plates lying between the septa. Both longitudinal and cross-sections show that there is a considerable amount of stereoplasm in the dissepimentarium.

The tabularium is divisible into two parts: an outer zone in which the tabulae are rather flat and evenly spaced; and an inner zone in which the tabulae are arched, blister-like plates that are largely incomplete. On the inner edge of the outer zone the tabulae are often strongly curved upwards and some of them may be seen to curve over into the inner zone. In the outer zone about 10 tabulae occupy the space of 5 mm., whereas in the inner zone there are about 15 in a space of 5 mm.

DISCUSSION. The general internal structure is like that of *Naos* (*N. pagoda*, genotype, Salter, 1873, p. 113; Lang, 1926B, p. 429, pl. XXX, figs. 1-3, text fig. 2, nos. 3, 4 on page 431). Its septal arrangement is like that of the genotype and also the corallum is divided into a dissepimentarium and tabularium. The tabularium of our species differs in that it is divided into two parts and in this respect is similar to that of *Tortophyllum* (Sloss, 1939, p. 54). Since the septal structure is so much like that of *N. pagoda* it is being placed in this genus.

Externally this species is somewhat similar to that of *N. brownsportensis* although the calyx walls of *N. sewellensis* are not as strongly reflexed. Internally *N. sewellensis* differs in having the tabularium divided into two parts; furthermore the septa do not form a central reticulation as they do in *N. brownsportensis*.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. This is not a common species; collections from the following localities: 4-(6); 11-(36), (56); 16-(31); 41-(86). The collection at location 4 came from a horizon about 38 feet above the base of the formation; the other collections are from the upper 50 feet of the Brownsport.

Naos brownsportensis Amsden, n. sp.

Plate XXXI, figs. 1-5

DESCRIPTION. This species has a solitary, cylindrical corallum which is slightly compressed so that it is elliptical in cross-section. The inner cup of the calyx is rather shallow and has a relatively small diameter, a corallum with a diameter of 30 mm. having a calyx which is only 10 mm. in diameter. The lip of the calyx is reflexed so that in some places its outer edges slope back towards the base of the corallum. The successive positions occupied by this calyx lip are reflected on the outer edge of the corallum in a series of expansions. On the inner wall of the calyx are low septal ridges which extend out onto the reflexed lip and back down the sides of the corallum. Figure 1 of plate XXXI shows these ridges and the expansions on the side of the corallum. The specimen shown in this figure is the most complete one in the collection, measuring 70 mm. long and 25 mm. in diameter at the point of greatest width.

There are 55 to 70 septa present in a mature corallum, which become broken up into an irregular tangle in the central part of the corallum as shown in figure 2 of plate XXXI. In the section shown in this figure the septal network fills the entire central portion but another specimen which appears to be similar in all other respects has a small area around the axis which is free of septal material. In the area immediately surrounding this central reticulation the septa are normal but as they progress towards the periphery they assume a zigzag course and further out, near the periphery, some of them become discontinuous (pl. XXXI, figs. 2, 4). In this outer zone some of the septa are represented only by septal crests on the dissepiments as is shown in the tangential section of figure 5, plate XXXI.

The corallum is divided into a well marked tabularium and dissepimentarium with the latter occupying the outer two-thirds of the corallite. The dissepiments are strongly arched upwards and in general tend to be smaller on the inner edge of the dissepimentarium, increasing in size towards the periphery. They are arranged in rows which are inclined upwards in the area next to the tabularium, becoming horizontal as they pass outwards and in some places near the periphery they may be inclined downwards (pl. XXXI, fig. 3). These dissepimental rows undoubtedly reflect the successive positions occupied by the calyx lip as the coral grew upwards. The tabulae are flat to convex plates, many of which are incomplete. They vary greatly in their spacing, being packed close together in one part of the corallum and widely spaced in another (pl. XXXI, fig. 3). There is some stereoplasm present in both the dissepimentarium and tabularium.

DISCUSSION. This species has a smaller diameter than *N. pagoda* (Salter, 1873, p. 113; Lang, 1926B, p. 429, pl. XXX, figs. 1-4, text fig. 1 on p. 430, text fig. 2 on p. 431) and the expansions on the sides of the corallum are spaced much closer together than are those of Salter's species. Furthermore the grooves on the outer lip of *N. pagoda* are coarser and spaced much further apart than they are in *N. brownsportensis*. The internal structure of these two species is similar although there appears to be more secondary material present in *N. pagoda*. Also the septa of *N. pagoda* do not form a network in the central part of the corallum as they do in *N. brownsportensis*.

DISTRIBUTION. Silurian, Brownsport formation of western Tennessee. This is a rare species; collections from the following localities: 4-(6); 36-(105); 39-(129).

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Figure II. Glade at location 18, Blue Mound glade, Perryville quadrangle. The strata in the foreground lie about 40 feet above the base of the Brownsport formation.



Figure III. Glade at location 4, old Brownsport Furnace, Perryville quadrangle. The strata in the foreground lie about 38 feet above the base of the Brownsport formation.



Figure v. Glade at location 4, old Brownsport Furnace, Perryville quadrangle. The limestone ledge shown in the foreground lies 25 feet above the base of the Brownsport.



Figure vii. Contact of the Dixon red clay (below) with the Brownsport formation; contact lies just below the projecting ledge. Location 42, Martins Mills quadrangle.

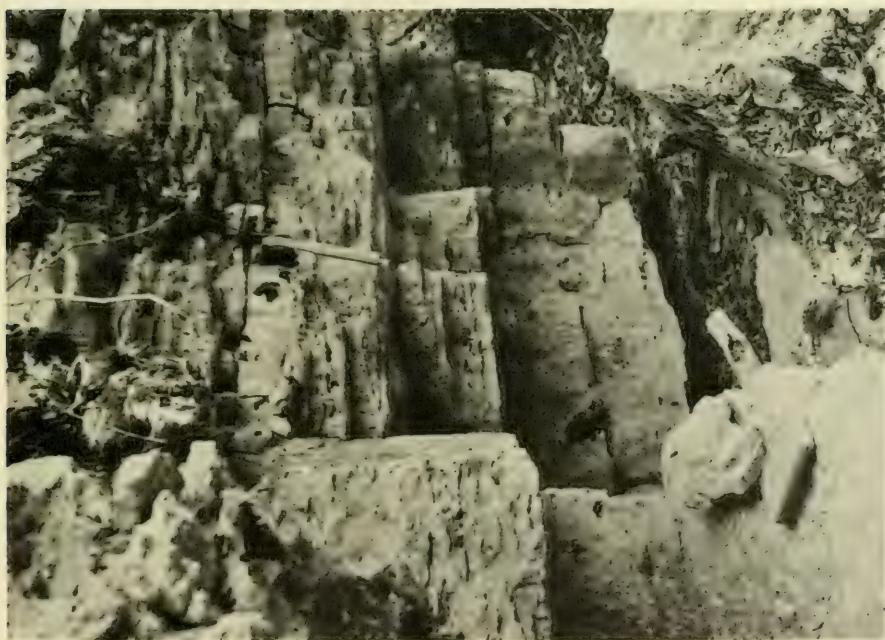


Figure VIII. View of the lower 7 or 8 feet of the Decatur limestone at locality 38, Lobelville quadrangle.

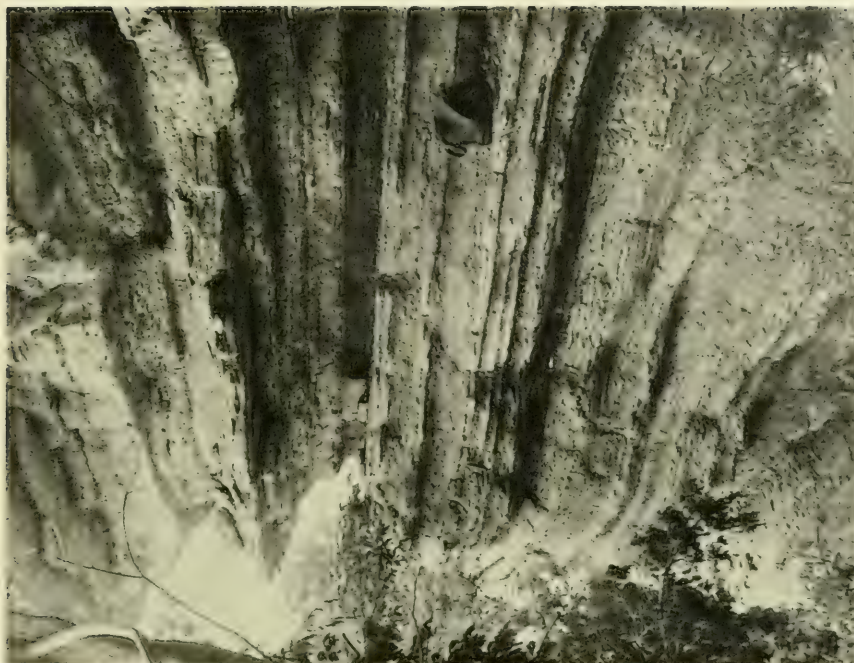


Figure IX. View of the uppermost Brownsport strata at location 14, Jeannette quadrangle. The Decatur limestone lies just above the highest beds seen in this picture.



Figure x. Contact of the Decatur limestone (above) with the Brownsport formation; contact lies at the base of the projecting ledge at top of the picture. Location 14, Lady Finger Bluff, Jeannette quadrangle.

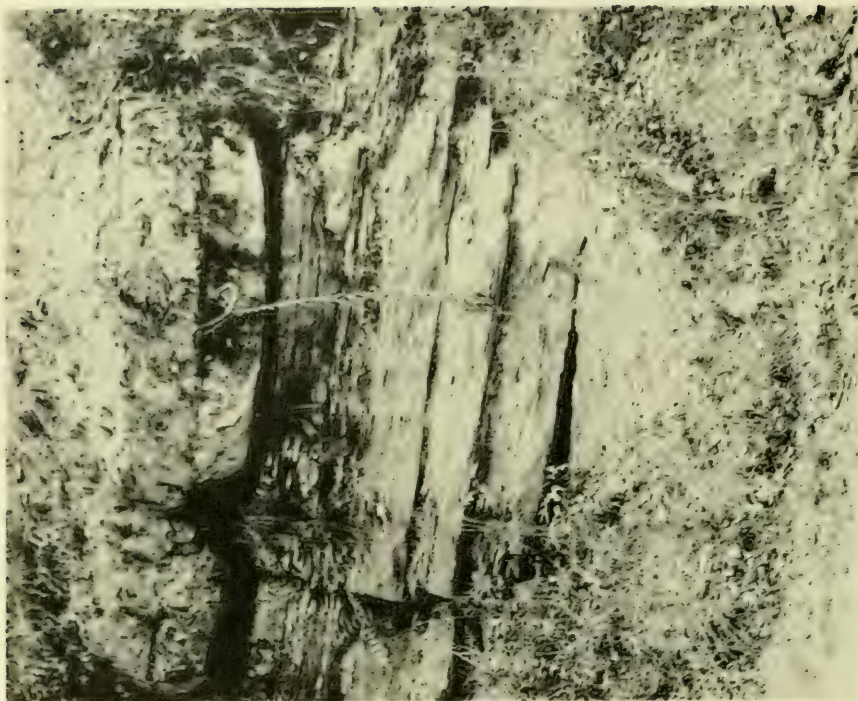


Figure xii. Contact of the massive-bedded Hardin sandstone (above) with the thin-bedded Brownsport formation. Location 43, Martins Mills quadrangle.

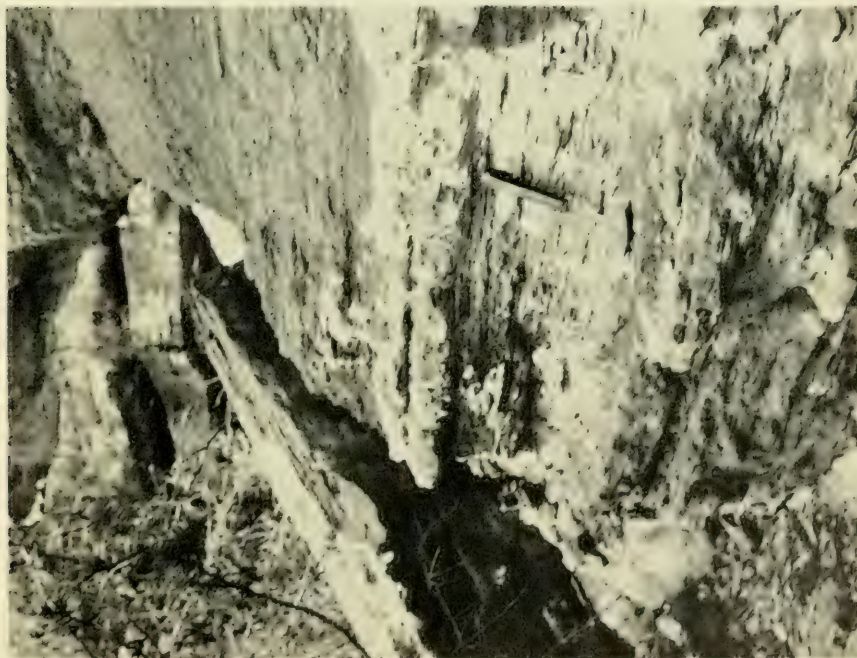


Figure XIII. View of the Brownsport strata exposed at location 13, Jeannette quadrangle. The uppermost beds visible lie 20 feet below the Decatur-Brownsport contact.

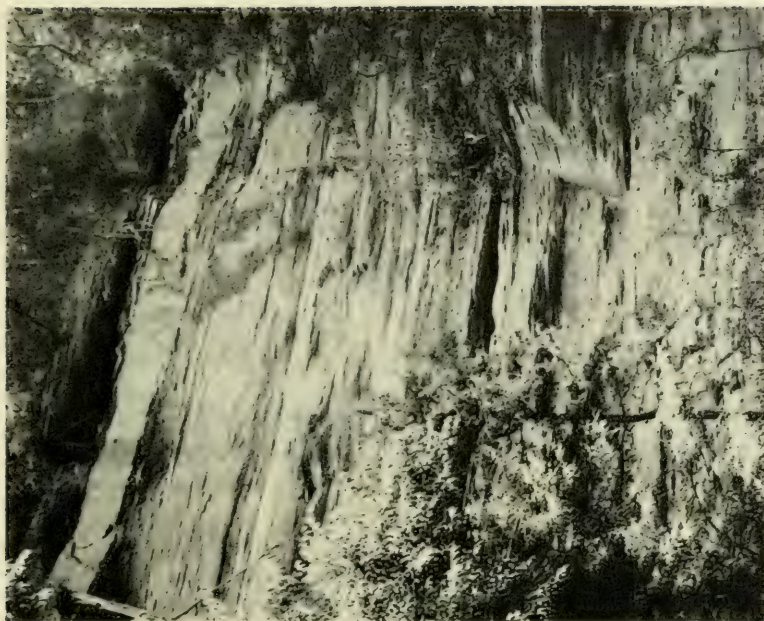


Figure XIV. View of the Brownsport formation at old Rise Mill (location 37, Linden quadrangle). A few feet of Dixon red beds are exposed in the lower part of the picture. The massive limestone ledge shown near the top is the "Bob" which lies 31 feet below the Hardin-Brownsport contact.



Figure xv. View of part of the Brownsport beds exposed at location 33, just north of Bob's Landing. The top of the limestone ledge shown in this picture lies 25 feet below the Decatur-Brownsport contact.



Figure xvi. View of the upper part of the Brownsport beds exposed at location 8, Clifton quadrangle. The lowest beds seen lie about 80 feet above the Dixon-Brownsport contact.



Figure xvii. View of the 17-foot unit of thick-bedded, non-argillaceous limestone ("Bob") at location 14, Jeannette quadrangle. A closer view of the lower contact of this limestone is shown in fig. xviii.

The river level was 20 to 25 feet higher in 1946 when this picture was taken than in 1942 when section 14 (fig. 19) was measured.

Photograph by C. O. Dunbar.



Figure xviii. View of the contact of the 17-foot unit of thick-bedded, non-argillaceous limestone ("Bob") with the underlying thin-bedded, argillaceous limestones and calcareous shales. This picture was taken at the south (left) end of the bluff shown in fig. xvii.

Photograph by C. O. Dunbar.



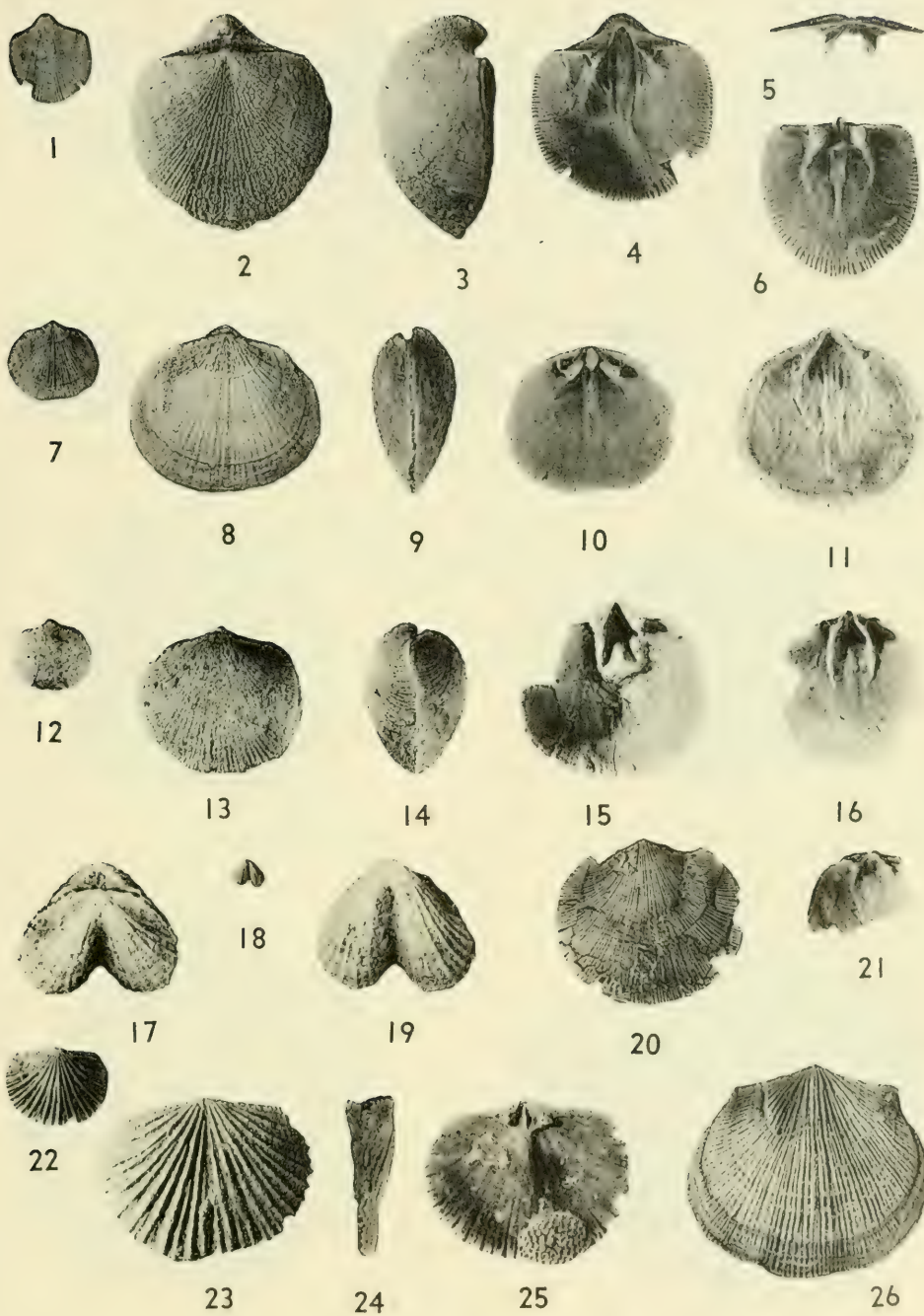
Figure xxx. A large specimen of *Favosites louisvillensis*? Davis. The corallum is lying with its upper surface down on the glade at location 28. The tape is extended 3 feet.

PLATES I TO XXXIV

The entire collection from the Brownsport formation, including the specimens illustrated on the following plates, are in Peabody Museum, Yale University. The only figures which have been retouched are: plate VII, fig. 9; plate VIII, fig. 25; plate XI, figs. 9, 18; plate XII, fig. 17.

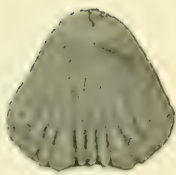
PLATE I

- Figs. 1-6. *Parmothis brownsportensis* Amsden, n. sp.
 1, 4. Ventral exterior (x 1) and ventral interior (x 2) views of the same specimen. Y.P.M. 17512. Locality 9-(3).
 2, 3. Dorsal and lateral views of the holotype (x 2). Y.P.M. 17510. Locality 9-(3).
 5. Posterior view of a dorsal valve (x 2). Y.P.M. 17511. Locality 18-(2).
 6. Same specimen viewed from above (x 2).
- Figs. 7-11. *Mendacella cliftonensis* Amsden, n. sp.
 7. Ventral view of the holotype (x 1). Y.P.M. 15716. Locality 18-(2).
 8-9. Dorsal and lateral views of holotype (x 2).
 10. Dorsal interior showing fulcral plate (x 2). Y.P.M. 15718. Locality 7-(11).
 11. Ventral interior (x 2). Y.P.M. 15717. Locality 9-(3).
- Figs. 12-16. *Isorthis arcuaria* (Hall and Clarke).
 12. Ventral exterior (x 1). Y.P.M. 17513. Locality 19-(19).
 13, 14. Dorsal and lateral views of the same specimen (x 2).
 15. Ventral interior showing the deeply impressed, bilobed muscle field (x 2). Y.P.M. 17514. Locality 25-(4).
 16. Dorsal interior (x 2). Y.P.M. 17519. Locality 19-(19).
- Figs. 17-19. *Bilobites* cf. *B. bilobus* (Linnaeus).
 17, 19. Dorsal and ventral views (x 5). Y.P.M. 17519. Locality 19-(19).
 18. Ventral view of the same specimen (x 1).
- Figs. 20-21. *Mendacella?* *lenticularis* (Foerste).
 20. Ventral view of a slightly crushed specimen (x 1). Y.P.M. 17519. Locality 4-(44).
 21. Ventral interior (x 1). Y.P.M. 17520. Locality 9-(3).
- Figs. 22-25. *Schizoramma fissiplica* (Roemer).
 22. Ventral exterior (x 1). Y.P.M. 17524. Locality 4-(9).
 24. Lateral view of the same specimen (x 2).
 23, 25. Dorsal exterior and interior views of the same specimen (x 2). Y.P.M. 17526. Locality 4-(9).
- Fig. 26. *Orthostrophia brownsportensis* Amsden, n. sp.
 26. Ventral view of the holotype (x 1). Y.P.M. 17851. Locality 18-(2).

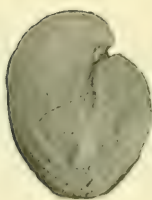




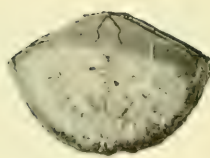
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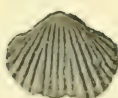
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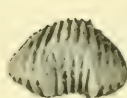
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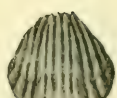
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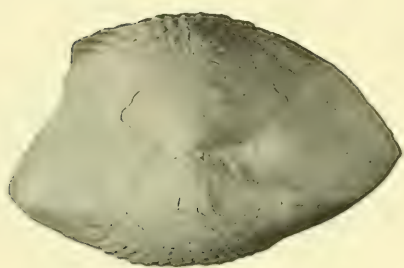
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PLATE II

- Figs. 1-4. *Sieberella roemeri* Hall and Clarke.
1-3. Ventral, dorsal, lateral views of a large specimen (x 1). Y.P.M. 17527. Locality 18-(13).
4. Polished section of a smaller individual. Note that the septal plates unite just at the floor of the valve (x 2). Y.P.M. 17528. Locality 9-(18).
- Figs. 5-9. *Anastrophia acutiplicata* Amsden, n. sp.
5-8. Dorsal, ventral, lateral, and anterior views of the holotype. Note that the fold and sulcus are well defined in the anterior portion of the shell (x 1). Y.P.M. 17521. Locality 18-(2).
9. Dorsal view of a different specimen which is somewhat crushed in the anterior portion (x 1). Y.P.M. 17522. Locality 9-(3).
- Figs. 10-13. *Rhipidium sewellense* Amsden, n. sp.
10-11. Posterior and lateral views of the same specimen (x 1). Y.P.M. 17596. Locality 11-(56).
12. Dorsal view (x 1). Y.P.M. 17597. Locality 11-(56).
13. Ventral view (x 1). Y.P.M. 17598. Locality 11-(56).

PLATE III

Figs. 1-2. *Rhipidium pingue* Amsden, n. sp.

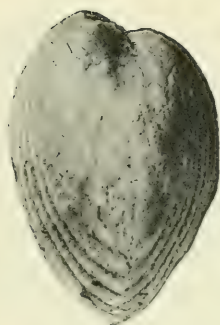
1. Lateral view (x 1). Y.P.M. 17590. Locality 11-(56).
2. View of a free dorsal valve (x 1). Y.P.M. 17591. Locality 11-(56).

Figs. 3-5. *Rhipidium sewellense* Amsden, n. sp.

- 3-4. Lateral and dorsal views of a paratype (x 1). This specimen was sectioned (see text fig. 25). Y.P.M. 17599. Locality 11-(56).
5. Lateral view of the holotype (x 1). Y.P.M. 17595. Locality 11-(56).



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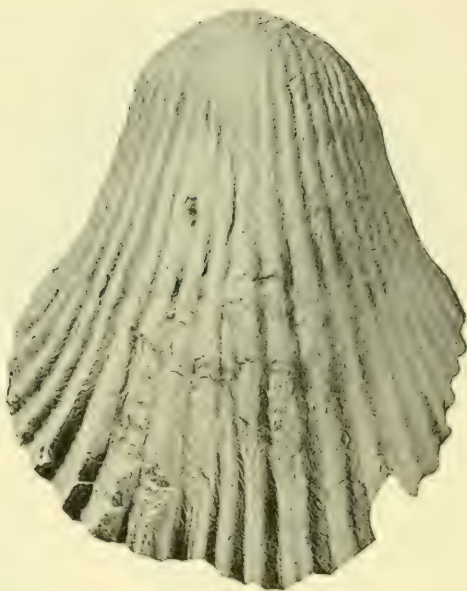
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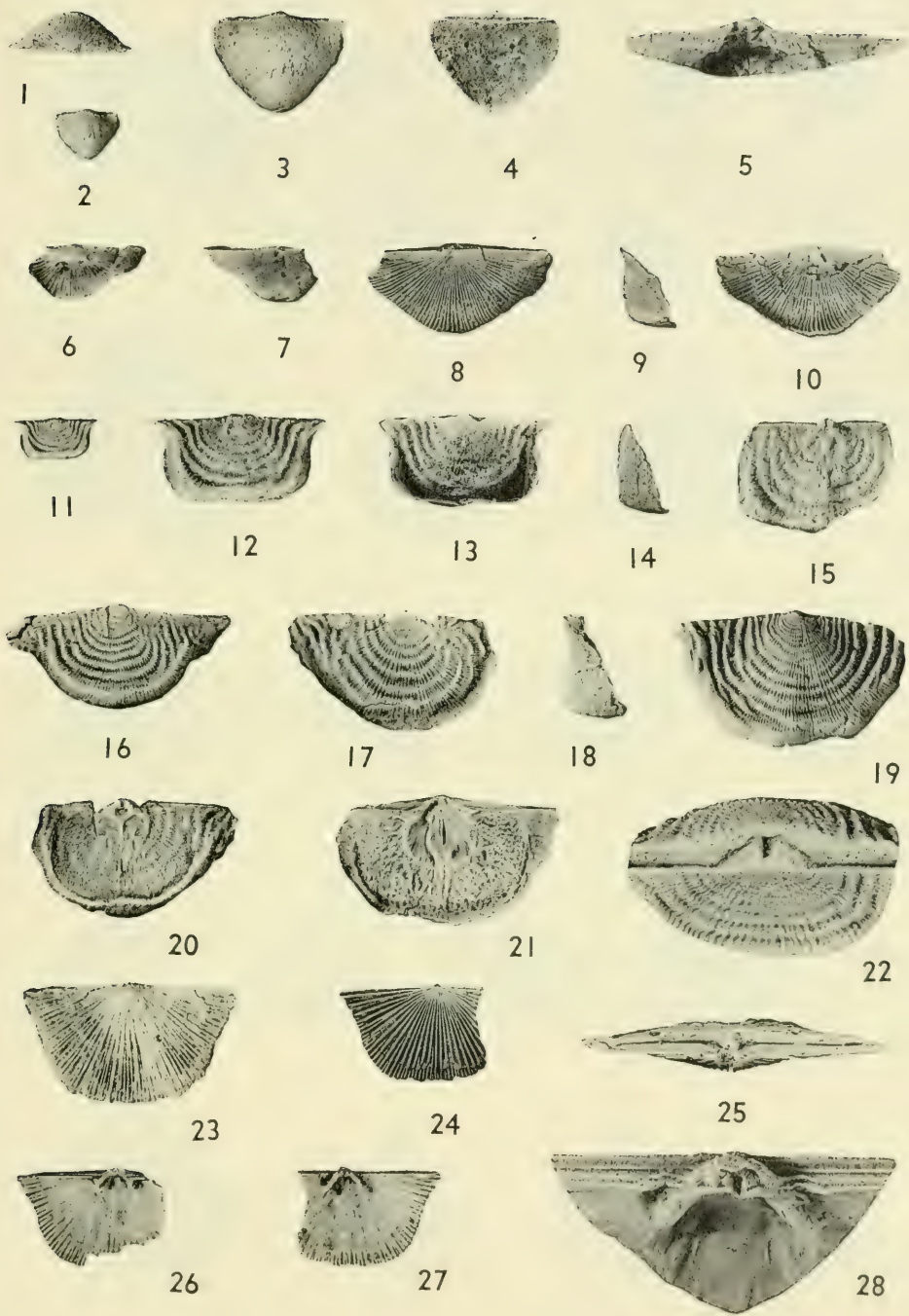
PLATE IV

Figs. 1-4. *Rhipidium pingue* Amsden, n. sp.

1. Lateral view of a ventral valve (x 1). Y.P.M. 17592. Locality 11-(56).
2. Ventral view of the same specimen (x 1).
- 3-4. Lateral and dorsal views of the holotype (x 1). Y.P.M. 17589. Locality 11-(56).

PLATE V

- Figs. 1-5. *Brachyprion? glabella* Amsden, n. sp.
 1. Posterior view of holotype (x 2). Y.P.M. 17529. Locality 4-(9).
 2. Ventral view of holotype (x 1).
 3, 4. Ventral and dorsal views of holotype (x 2).
 5. Cardinal area of ventral valve showing small beak and denticulation (x 4). Y.P.M. 17530. Locality 18-(2).
- Figs. 6, 7. *Strophonella dixonii* Foerste.
 6-7. Ventral and dorsal views of the same specimen (x 1). Y.P.M. 17531. Locality 18-(2).
- Figs. 8-10. *Strophonella prolongata* Foerste.
 8-10. Dorsal, lateral, and ventral views of the same specimen (x 1). Y.P.M. 17532. Locality 4-(9).
- Figs. 11-15. *Leptaena delicata* Amsden, n. sp.
 11. Ventral view of the holotype (x 1). Y.P.M. 17480. Locality 18-(2).
 12-14. Ventral, lateral, and dorsal views of the holotype (x 2).
 15. Ventral interior (x 2). Y.P.M. 17481. Locality 22-(15).
- Figs. 16-22. *Leptaena tennesseensis* Amsden, n. sp.
 16, 18. Ventral and lateral views of the same specimen (x 1). Y.P.M. 17488. Locality 18-(13).
 17, 20. Views of the dorsal exterior and dorsal interior of the holotype (x 1). Y.P.M. 17485. Locality 9-(3).
 19, 21. Ventral exterior and ventral interior of the same specimen (x 1). Y.P.M. 17486. Locality 18-(13).
 22. Cardinal area of articulated valves, ventral valve uppermost (x 4). Y.P.M. 17487. Locality 4-(1).
- Figs. 23-28. *Fardenia roemeri* (Foerste).
 23. Ventral view (x 1). Y.P.M. 17484. Locality 4-(14).
 24, 27. Dorsal exterior and dorsal interior (x 1). Y.P.M. 17482. Locality 4-(14).
 25. Posterior view of articulated valves. Dorsal valve uppermost. Note large chilidium (x 2). Y.P.M. 17483. Locality 18-(2).
 26. Ventral interior showing short but distinct dental plates and small deltidium. This valve articulates with the dorsal valve in fig. 24 (x 1). Same catalogue No. and locality No. as fig. 24.
 28. View showing the cardinal process and chilidium of a dorsal valve (x 5). Y.P.M. 17618. Locality 18-(2).



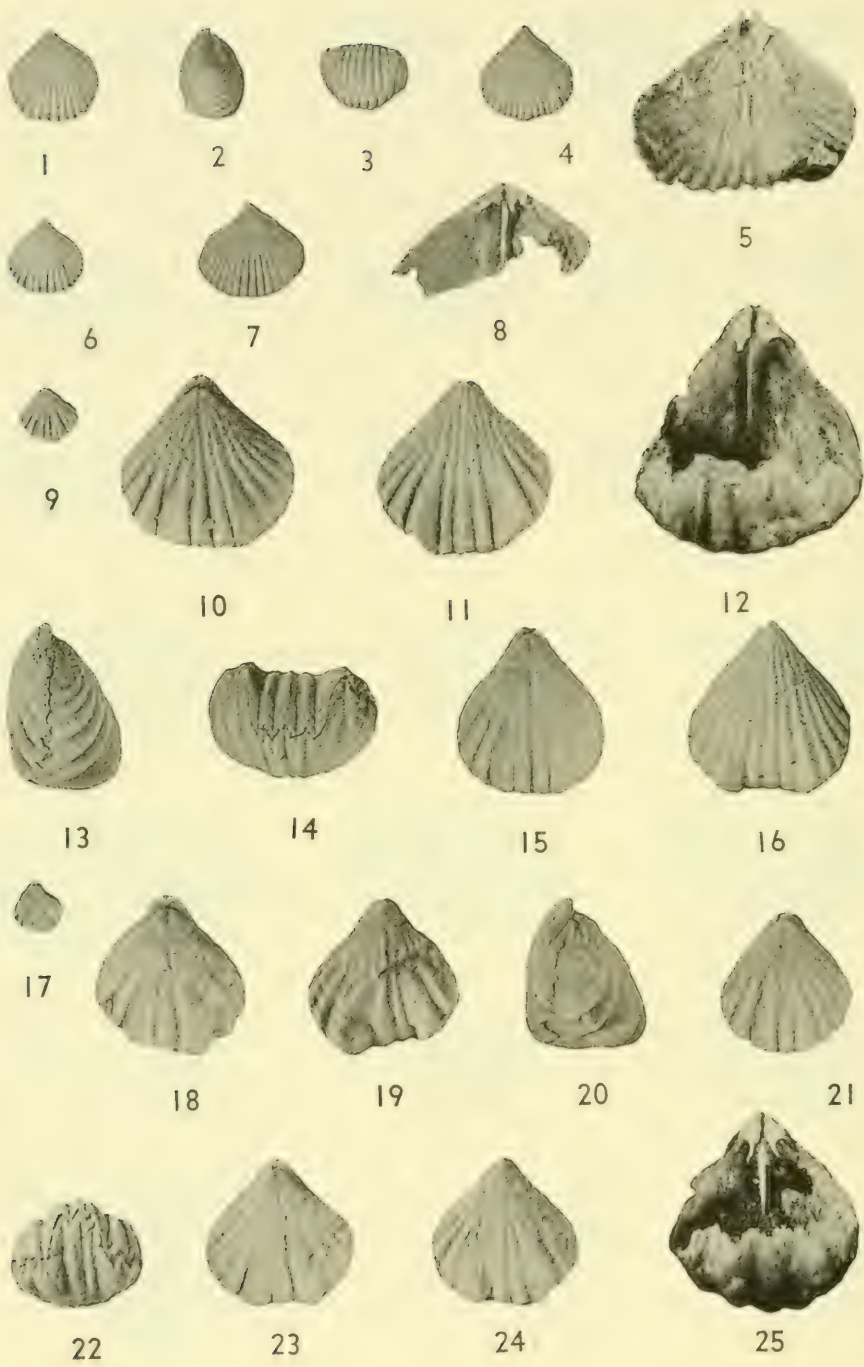
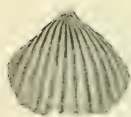


PLATE VI

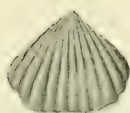
- Figs. 1-8. *Camarotoechia perryvillensis* Amsden, n. sp.
1-3. Dorsal, lateral, and anterior views of the holotype (x 1). Y.P.M. 17541. Locality 18-(2).
4. Ventral view of another specimen (x 1). Y.P.M. 17542. Locality 18-(2).
5, 8. Ventral and dorsal interior views of the same individual (x 3). Note median septum in ventral valve. Y.P.M. 17545. Locality 18-(2).
6. Dorsal view of a smaller individual (x 1). Y.P.M. 17544. Locality 18-(2).
7. Dorsal view of another specimen (x 1). Y.P.M. 17543. Locality 18-(13).
- Figs. 9-16. *Camarotoechia shannonensis* Amsden, n. sp.
9. Dorsal view of the holotype (x 1). Y.P.M. 17553. Locality 18-(2).
10-11, 13, 14. Dorsal, ventral, lateral, and anterior views of the holotype (x 3).
12. Dorsal interior (x 5). Y.P.M. 17556. Locality 18-(2).
15. Dorsal view of another specimen (x 3). Y.P.M. 17554. Locality 18-(2).
16. Ventral view (x 3). Y.P.M. 17555. Locality 25-(4).
- Figs. 17-25. *Camarotoechia eccentrica* Amsden, n. sp.
17. Dorsal view (x 1). Y.P.M. 17550. Locality 18-(2).
18-20. Dorsal, ventral, and lateral views of the same specimen (x 3).
21-22. Dorsal and anterior views of holotype (x 3). Y.P.M. 17549. Locality 18-(2).
23-24. Dorsal and ventral views of another specimen (x 3). Y.P.M. 17551. Locality 18-(13).
25. Dorsal interior (x 5). Y.P.M. 17552. Locality 18-(2).

PLATE VII

- Figs. 1-9. *Camarotoechia cedarensis* Amsden, n. sp.
1-4. Dorsal, ventral, lateral, and anterior views of the holotype (x 1). Y.P.M. 17538, Locality 18-(2).
5-6. Lateral and posterior views of another individual (x 1). Y.P.M. 17539, Locality 4-(6).
7. Ventral interior (x 2). Y.P.M. 17540, Locality 18-(2).
8. Enlarged view (x 5) of the surface of the holotype showing surface ornamentation.
9. Dorsal interior view (x 5). Y.P.M. 17540, Locality 18-(2). Retouched.
- Figs. 10-14. *Camarotoechia acutiplicata* Amsden, n. sp.
10-13. Dorsal, ventral, lateral, and anterior views of the holotype (x 1). Y. P. M. 17546, Locality 18-(2).
14. Dorsal interior (x 5). Y.P.M. 17547, Locality 9-(3).
- Figs. 15-25. *Trigonirhynchia tennesseensis* (Roemer) emend. Amsden.
15-18. Dorsal, ventral, lateral, and anterior views of a specimen (x 1). Y.P.M. 17533, Locality 18-(2).
19-20. Posterior and lateral views of another specimen (x 1). Y.P.M. 17534, Locality 4-(14).
21, 24. Dorsal interior views of an immature specimen. Fig. 24 is viewed from directly above; fig. 21 is an oblique view which shows the cardinal process to better advantage (both x 5). Y.P.M. 17537, Locality 9-(3).
22. Ventral interior (x 2). Y.P.M. 17535, Locality 9-(3).
25. Enlarged view of the same specimen showing the nature of the deltidial plates (x 5).
23. Cardinal process of a mature individual (x 5). Y.P.M. 17536, Locality 18-(13).



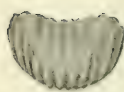
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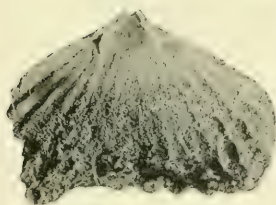
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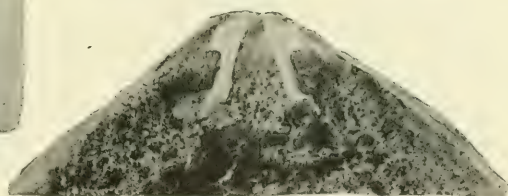
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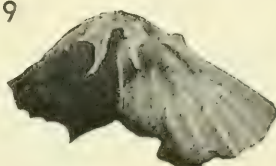
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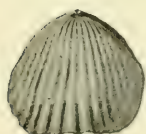
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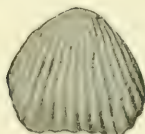
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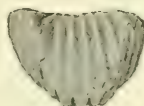
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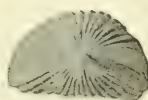
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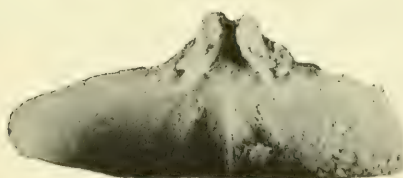
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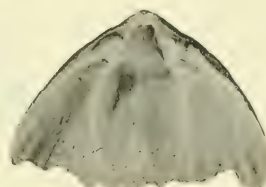
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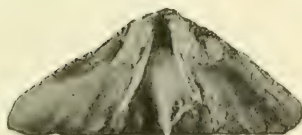
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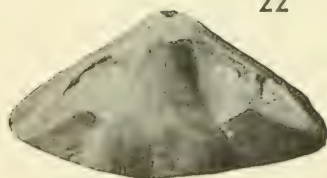
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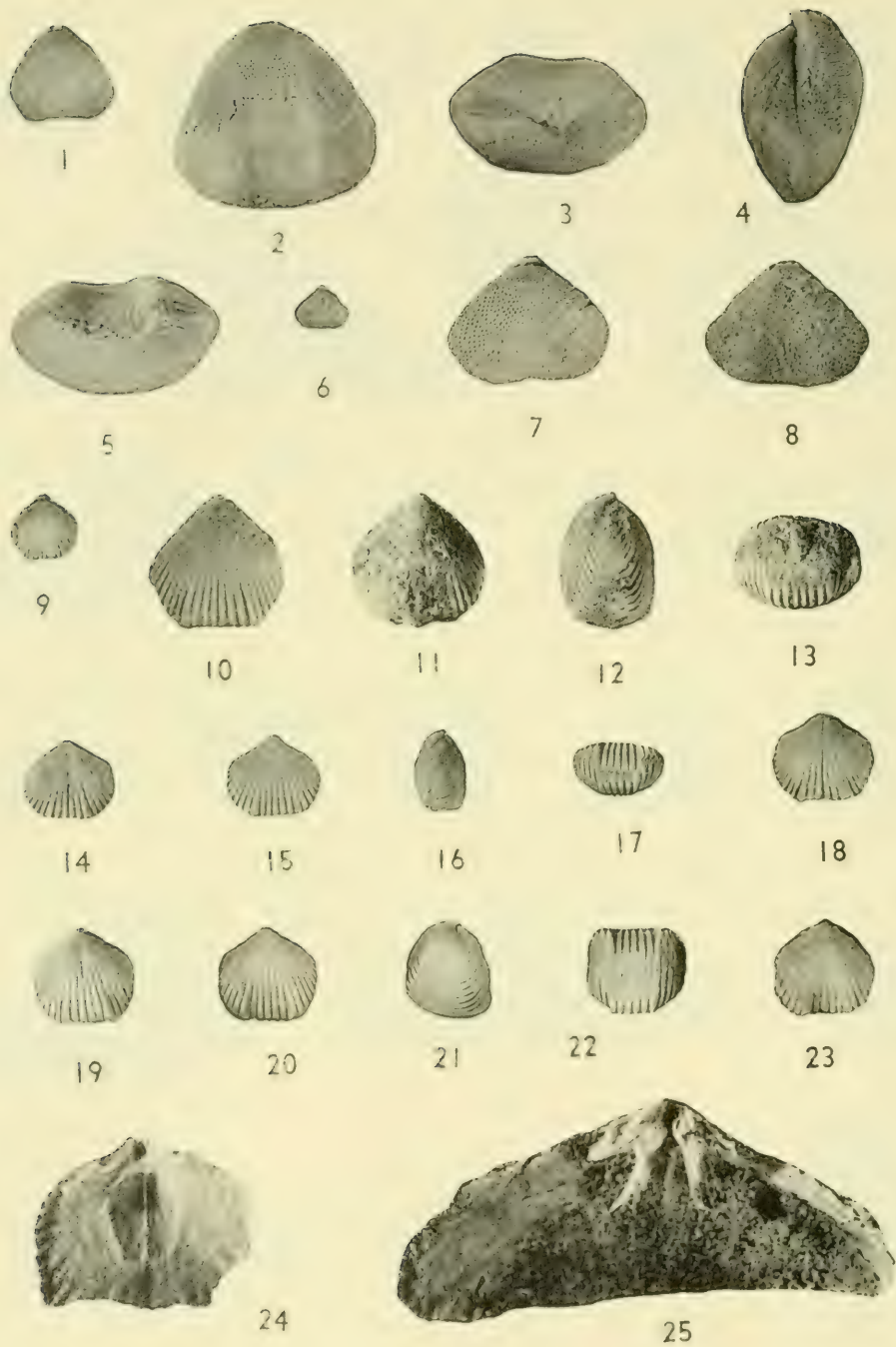
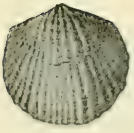


PLATE VIII

- Figs. 1-8. *Dictyonella gibbosa* (Hall).
1. Dorsal exterior (x 1). Y.P.M. 17566. Locality 18-(2).
2-5. Ventral, posterior, lateral, and anterior views of the same specimen (x 2).
6. Dorsal view of a small individual (x 1). Y.P.M. 17567. Locality 18-(2).
7-8. Dorsal and ventral views of the same specimen (x 3).
- Figs. 9-13. *Wilsonella*? sp.
9. Dorsal view (x 1). Y.P.M. 17565. Locality 4-(14).
10-13. Dorsal, ventral, lateral, and anterior views of the same specimen (x 2).
- Figs. 14-18. *Wilsonella*? *compressa* Amsden, n. sp.
14-17. Dorsal, ventral, lateral, and anterior views of holotype (x 1). Y.P.M. 17489. Locality 18-(2).
18. Dorsal view of another specimen (x 1). Y.P.M. 17490. Locality 18-(2).
- Figs. 19-25. *Wilsonella saffordi* (Hall).
19-22. Dorsal, ventral, lateral, and anterior views (x 1). Y.P.M. 17477. Locality 18-(2).
23. Ventral view of another specimen (x 1). Y.P.M. 17476. Locality 19-(16).
24. Ventral interior (x 2). Y.P.M. 17478. Locality 18-(2).
25. Dorsal interior (x 5). Y.P.M. 17479. Locality 4-(1). Retouched.

PLATE IX

- Figs. 1-9. *Atrypa tennesseensis* Amsden, n. sp.
1-3. Dorsal, lateral, and anterior views of the holotype (x 1). Y.P.M. 17571. Locality 18-(2).
4-5. Ventral and posterior views of another individual (x 1). Y.P.M. 17573. Locality 18-(2).
6. Dorsal view of an unusually large specimen (x 1). Y.P.M. 17572. Locality 18-(2).
7. Ventral interior (x 2). Y.P.M. 17574. Locality D-6.
8. Dorsal view of spiralia and jugum (x 2). Y.P.M. 17576. Locality 18-(2).
9. View of dorsal interior minus spiralia (x 2). Y.P.M. 17575. Locality 18-(2).
- Figs. 10-15. *Atrypa arctostriata* Foerste.
10-12. Dorsal, lateral, and anterior views of the same specimen (x 1). Y.P.M. 17563. Locality 4-(44).
13. Ventral view of a small individual (x 1). Y.P.M. 17562. Locality 4-(44).
14. Dorsal view of another small specimen (x 1). Y.P.M. 17564. Locality 4-(44).
15. Ventral view of a slightly larger specimen (x 1). Y.P.M. 17561. Locality 22-(15).
- Figs. 16-23. *Lissatrypa decaturensis* Amsden, n. sp.
16, 18. Dorsal (x 1) and ventral (x 3) views of the same individual. Y.P.M. 17558. Locality 18-(2).
17. Posterior view of another individual (x 3). Y.P.M. 17558. Locality 24-(12).
19-20. Ventral and lateral views of the holotype (x 3). Y.P.M. 17557. Locality 18-(2).
21. Dorsal view of spiralia and jugum (x 5). Y.P.M. 17560. Locality 18-(2).
22. Dorsal interior without spiralia (x 5). Y.P.M. 17560. Locality 18-(2).
23. Ventral interior (x 5). Y.P.M. 17560. Location 24-(12).



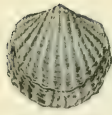
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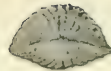
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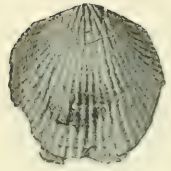
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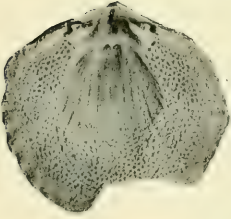
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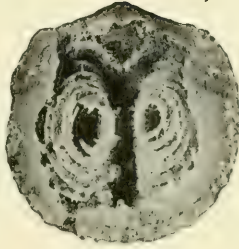
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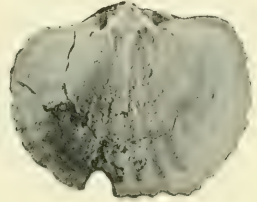
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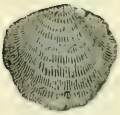
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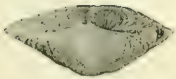
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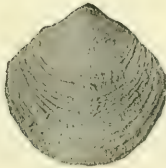
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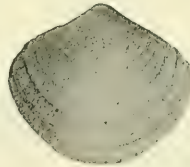
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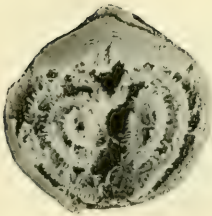
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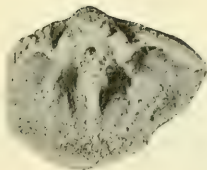
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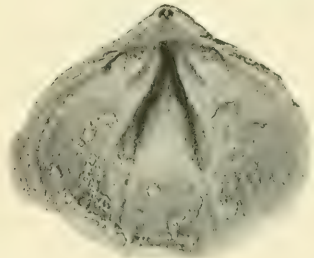
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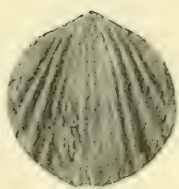
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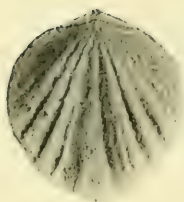
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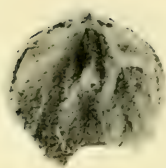
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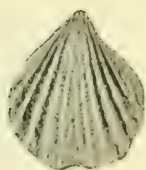
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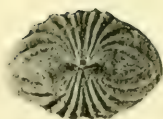
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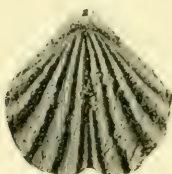
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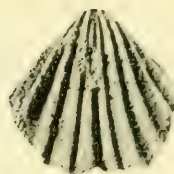
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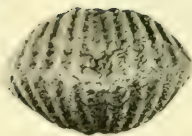
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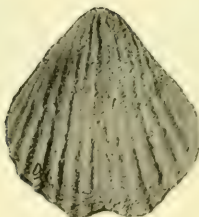
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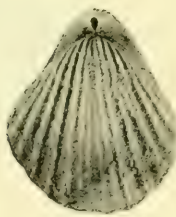
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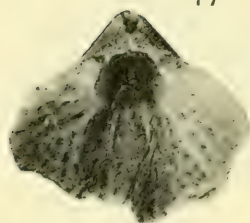
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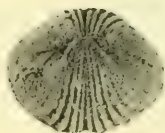
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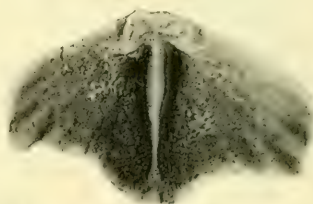
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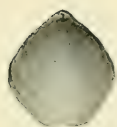
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PLATE X

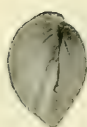
- Figs. 1-5. *Coelospira saffordi* (Foerste).
1, 3. Ventral and lateral views (x 5). Y.P.M. 17569. Locality 18-(2).
2. Ventral view of the same specimen (x 1).
4. Dorsal view of another specimen (x 5). Y.P.M. 17568. Locality 18-(2).
5. Ventral interior (x 5). Y.P.M. 17570. Locality 18-(13).
- Figs. 6-10. *Homoeospira schucherti* Foerste.
6. Dorsal exterior (x 1). Y.P.M. 17583. Locality 4-(1).
7-8. Ventral and lateral views of the same specimen (x 2).
9-10. Ventral and lateral views of another specimen (x 2). Y.P.M. 17584. Locality 4-(14).
- Figs. 11-15. *Homoeospira beecheri* Foerste.
11. Dorsal exterior (x 1). Y.P.M. 17496. Locality 18-(2).
12-15. Posterior, dorsal, ventral, and lateral views of same specimen (x 3).
- Figs. 16-23. *Homoeospira elongata* Foerste.
16. Dorsal view (x 1). Y.P.M. 17587. Locality 18-(2).
17-18. Anterior and ventral views of same specimen (x 3).
19-20. Dorsal and lateral views of another individual (x 3). Y.P.M. 17586. Locality 18-(2).
21. Ventral interior (x 5). Y.P.M. 17588. Locality 18-(2).
22. Posterior view (x 3). Y.P.M. 17585. Locality 18-(2).
23. Dorsal interior without spiralia (x 5). Y.P.M. 17588. Locality 18-(2).

PLATE XI

- Figs. 1-9. *Merista tennesseensis* Hall and Clarke.
- 1-3. Dorsal, lateral, and anterior views of same specimen (x 1). Y.P.M. 17579. Locality 9-(3).
 - 4-5. Ventral and posterior views of a different specimen (x 1). Y.P.M. 17578. Locality 25-(4).
 6. Dorsal view of a smaller specimen (x 1). Y.P.M. 17580. Locality 9-(3).
 7. Dorsal interior with spiralia absent showing median septum (x 5). Y.P.M. 17581. Locality 4-(1).
 8. Spiralia and jugum viewed from dorsal side (x 2). Attachment to dorsal valve has been broken away. Y.P.M. 17577. Locality 9-(3).
 9. Ventral interior showing dental plates and the hood-like process (x 2). Retouched. Y.P.M. 17582. Locality 4-(1).
- Figs. 10-20. *Delthyris saffordi* (Hall).
11. Dorsal view (x 1). Y.P.M. 17491. Locality 9-(18).
 - 10, 12, 19. Ventral, posterior, and lateral views of the specimen shown in fig. 11 (x 2).
 13. Dorsal view of a smaller specimen (x 2). Y.P.M. 17492. Locality 9-(18).
 14. Ventral interior showing dental plates and median septum (x 2). Y.P.M. 17495. Locality 18-(13).
 15. Ventral interior of a different specimen showing plug-like deposit in delthyrium (x 2). Y.P.M. 17493. Locality 9-(3).
 16. Dorsal interior showing plug-like deposit in umbonal cavity (x 2). Y.P.M. 17494. Locality 9-(3).
 17. Dorsal interior without plug-like deposit (x 2). This is the opposite valve to the ventral valve shown in fig. 14 and bears the same catalogue number.
 18. Enlarged ventral cardinal area view of the same specimen shown in fig. 11 (x 5). Retouched.
 20. Enlarged view of the same specimen showing the concentric lamellae with spines (x 6).



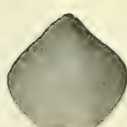
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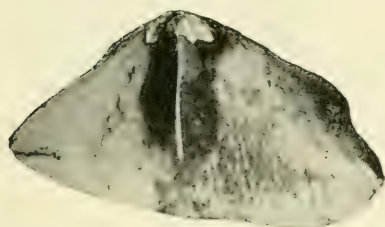
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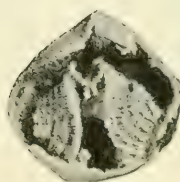
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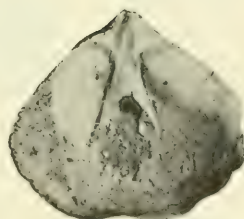
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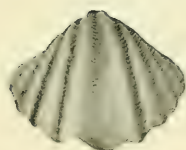
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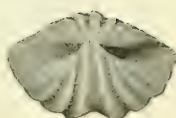
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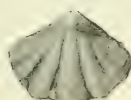
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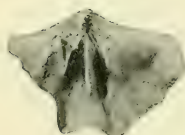
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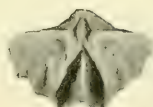
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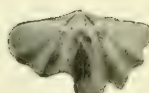
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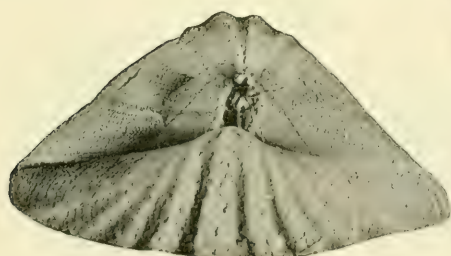
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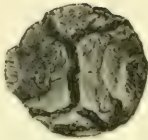
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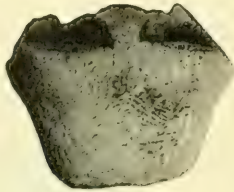
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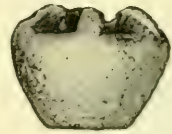
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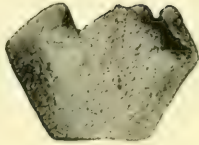
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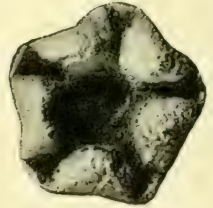
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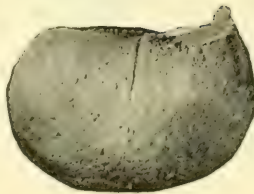
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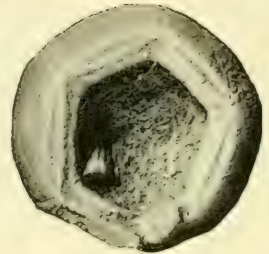
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PLATE XII

- Figs. 1-4. *Tetracystis bifarius* Amsden, n. sp.
1. Lateral view from anal side of holotype (x 2). Y.P.M. 17260. Locality 21-(25).
2. Lateral view of holotype showing one of the pectinate rhombs (x 1).
3. Oral view of same specimen showing ambulacral grooves, the two pectinate pore rhombs and the hydrospire (?) pore (x 2).
4. Lateral view of same specimen (x 2). This view is of the side opposite from the anal side; note that there is no trace of a basal rhomb.
- Figs. 5-7. *Troosticrinus reinwardti* (Troost).
5, 6. Oral and lateral views of the same specimen (x 1). Y.P.M. 17508. Locality 21-(25).
7. Enlarged view of one of the ambulacral grooves of the same specimen (x 5). Note the small outer side plates.
- Figs. 8, 9. *Thalamocrinus ovatus* Miller and Gurley.
8. Lateral view (x 5). Y.P.M. 17505. Locality 4-(6).
9. Lateral view of the same specimen (x 1).
- Figs. 10-11. *Pisocrinus tennesseensis* (Roemer).
10, 11. Lateral view (x 5) and lateral view (x 1) of the same specimen. Y.P.M. 17499. Locality 4-(6).
- Figs. 12-13. *Pisocrinus campana* Miller.
12. Lateral view (x 5). Y.P.M. 17497. Locality 4-(6).
13. Lateral view of a different specimen (x 1). Y.P.M. 17497. Locality 4-(6).
- Figs. 14-16. *Pisocrinus quinquelobus* Bather.
14. Lateral view (x 5). Y.P.M. 17500. Locality 4-(6).
15, 16. Lateral view (x 1) and oral view (x 5) of another specimen. Y.P.M. 17501. Locality 19-(16).
- Fig. 17. *Myelodactylus extensus* Springer.
17. Lateral view (x 2). Calyx hidden behind cirri. Y.P.M. 17502. Locality 11-(36).
- Figs. 18-20. *Lecanocrinus pisiformis* (Roemer).
18-20. Lateral view (x 5), lateral view (x 1), and oral view (x 5) of the same specimen. Y.P.M. 17506. Locality 19-(16).

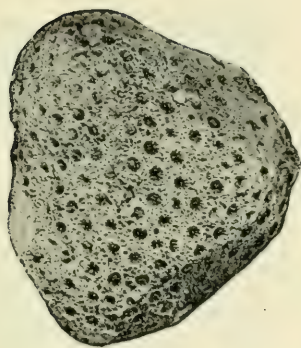
PLATE XIII

Figs. 1-4. *Plasmopora follis* Edwards and Haime.

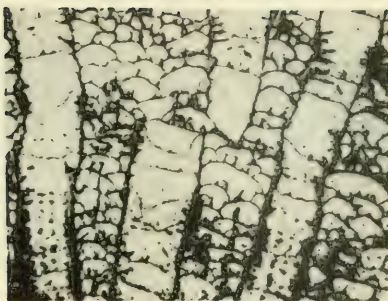
1. Complete view of a corallum (x 1). Y.P.M. 17605. Locality 11-(36).
2. Longitudinal thin section; note vesicular tissue between macrocorallites (x 5). Y.P.M. 17606. Locality 11-(36).
3. Enlarged (x 4) view of the surface of the same specimen shown in fig. 1.
4. Cross section of the same specimen as that of fig. 2 (x 5).

Figs. 5-9. *Cosmolithus sewellensis* Amsden, n. sp.

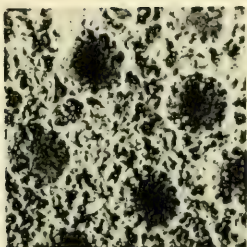
5. Enlarged view (x 4) of the surface. Y.P.M. 17603. Locality 11-(36).
6. Cross section; note the union of the septa in the center of macrocorallites (x 5). Y.P.M. 17602. Locality 11-(36).
7. View showing a portion of the corallum of the holotype (x 1). Y.P.M. 17600. Locality 11-(36).
8. Longitudinal section; this section has cut approximately through the center of two of the macrocorallites and shows the vesicular tissue caused by the union of the septa (x 5). Y.P.M. 17601. Locality 11-(36).
9. Longitudinal section cut from the same corallum as the cross section shown in fig. 6. This section does not intersect a macrocorallite (x 5). Y.P.M. 17602. Locality 11-(36).



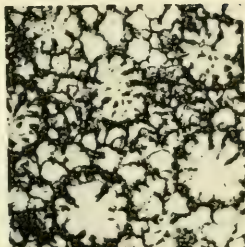
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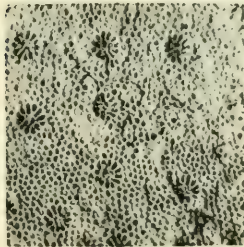
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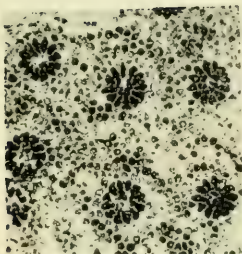
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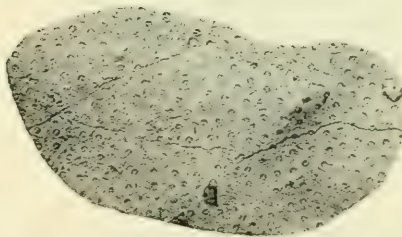
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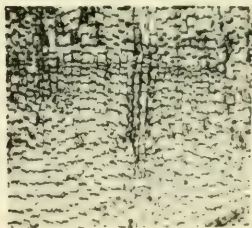
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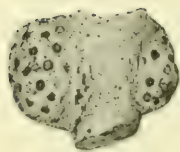
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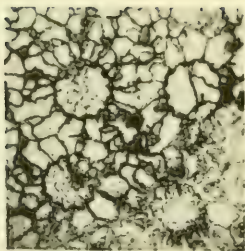
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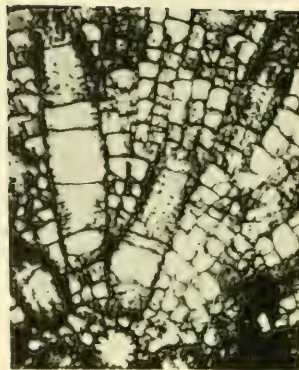
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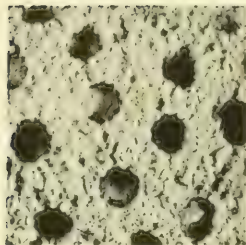
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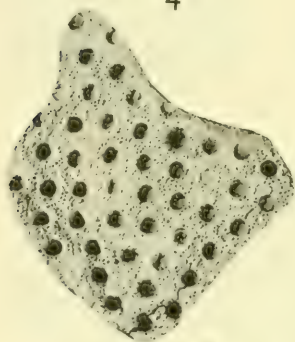
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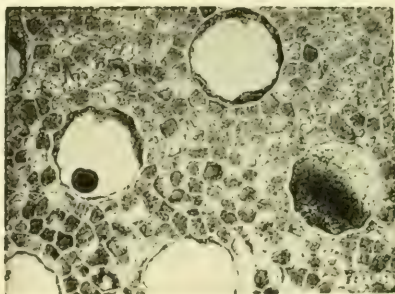
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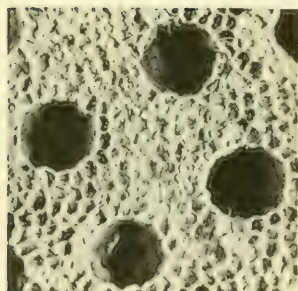
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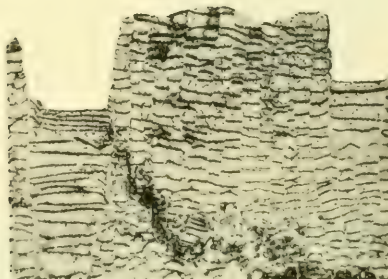
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PLATE XIV

Figs. 1-4. *Heliolites tennesseensis* Amsden, n. sp.

1. View of a colony growing attached to a crinoid stem; holotype (x 1). Y.P.M. 17611. Locality 4-(44).
2. Cross section of the holotype (x 5). Y.P.M. 17612.
3. Longitudinal section of another specimen (x 5). Y.P.M. 17613. Locality 4-(44).
4. Enlarged view of the surface of the holotype (x 4).

Figs. 5-8. *Heliolites spongiosus* Foerste.

5. Portion of a corallum (x 1). Y.P.M. 17615. Locality 11-(36).
6. Cross section of another specimen (x 5). Y.P.M. 17614. Locality 11-(36).
7. Enlarged view of the surface of the specimen shown in fig. 5 (x 4).
8. Longitudinal section taken from the same specimen shown in fig. 6 (x 5). Y.P.M. 17614. Same locality as fig. 6.

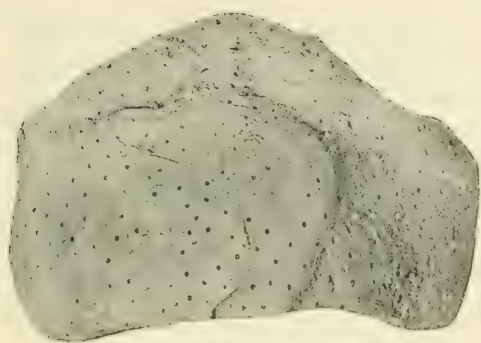
PLATE XV

Figs. 1-5. *Heliolites nucella* Foerste.

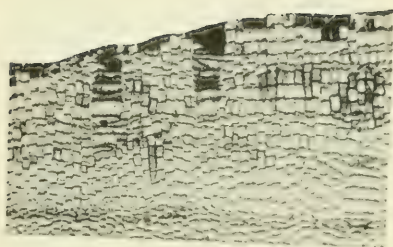
1. Upper surface of a colony which is almost complete (x 1). Y.P.M. 17609. Locality 14-(42).
2. Longitudinal section showing macrocorallites and microcorallites (x 5). Y.P.M. 17610. Locality 13-(41).
3. Lower surface of the same specimen shown in fig. 1; note wrinkled epitheca (x 1).
4. Enlarged view of the surface of the specimen shown in fig. 1 (x 4).
5. Cross section taken from the same specimen as fig. 2 (x 5).

Figs. 6-9. *Heliolites distans* Foerste.

6. View showing portion of a corallum (x 1). Y.P.M. 17607. Locality 11-(36).
7. Enlarged view of the same specimen (x 4).
- 8, 9. Cross section and longitudinal section taken from the same specimen (x 5). Y.P.M. 17608. Locality 11-(36).



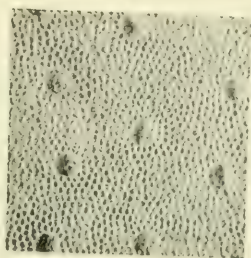
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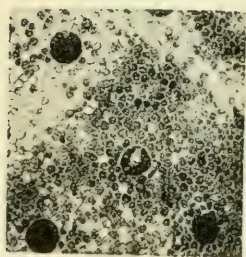
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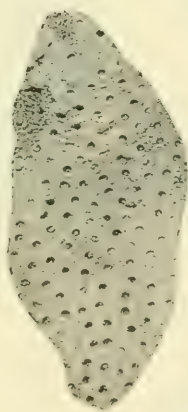
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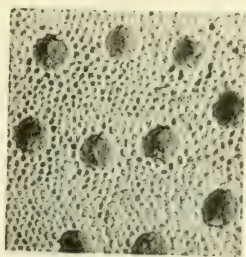
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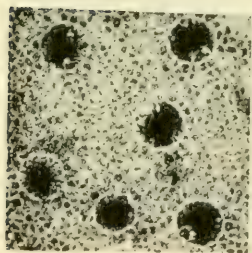
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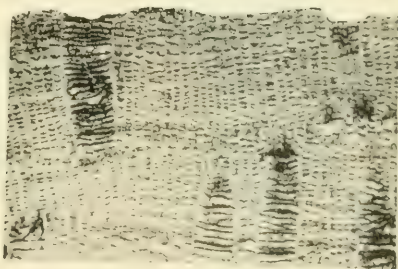
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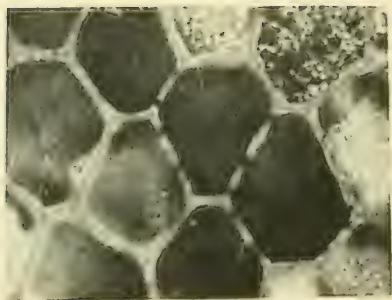
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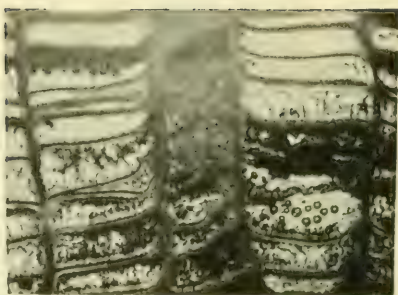
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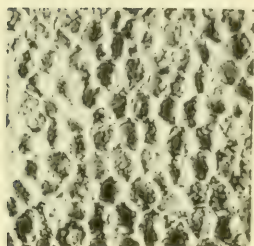
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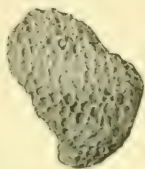
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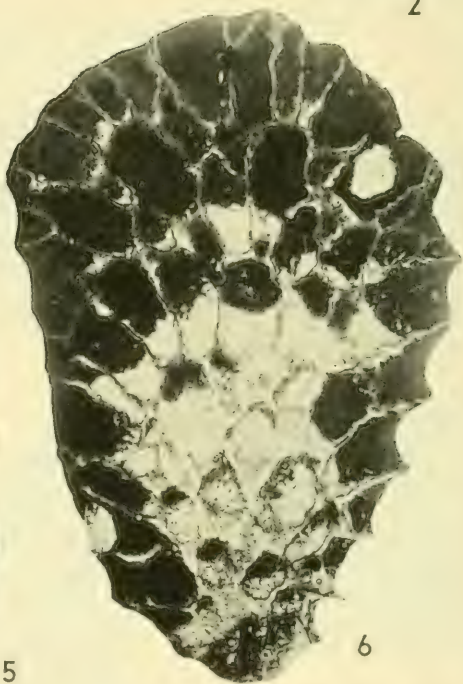
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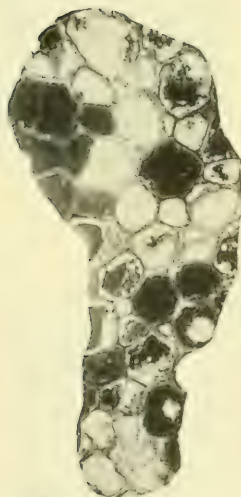
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PLATE XVI

Figs. 1-3. *Favosites brownsportensis* Amsden, n. sp.

1-2. Cross section and longitudinal section cut from the same corallum (x 5). Y.P.M. 17617. Locality 10-(26).

3. View of the upper surface of the holotype (x 1). Y.P.M. 17616. Locality 21-(25).

Figs. 4-9. *Favosites clavatulus* Amsden, n. sp.

4. View of the complete corallum of the holotype (x 1). Y.P.M. 17626. Locality 4-(44).

5. Complete corallum (x 1). This specimen later sectioned (see fig. 7). Y.P.M. 17628. Locality 18-(2).

6. Thin section cut very close to the axis of a corallum (x 5). Y.P.M. 17627. Locality 4-(44).

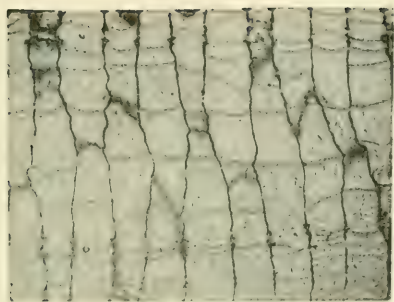
7. Cross section cut close to the outer edge of the corallum. This section made from the specimen shown in fig. 5.

8. View of another complete corallum (x 1). Y.P.M. 17627. Locality 18-(2).

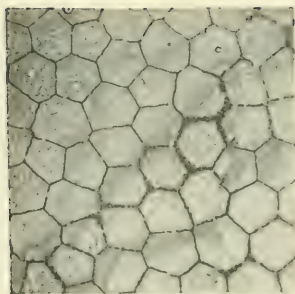
9. Enlarged view of the surface of the holotype (x 5).

PLATE XVII

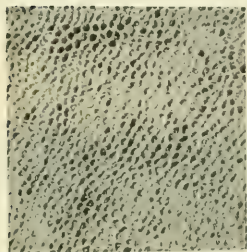
- Figs. 1-4. *Favosites louisvillensis*? Davis.
- 1-2. Longitudinal and cross sections cut from the same corallum (x 5). Y.P.M. 17623. Locality 13-(41).
 - 3. View of the upper surface of a corallum (x 1). Y.P.M. 17619. Locality 11-(36).
 - 4. The same corallum with the surface enlarged (x 5).
- Figs. 5-10. *Favosites beechensis* Amsden, n. sp.
- 5-7. Lateral, top, and bottom views of the holotype (x 1). Y.P.M. 17624. Locality 12-(27).
 - 8-9. Cross and longitudinal sections cut from the same corallum (x 5). Y.P.M. 17625. Locality 18-(13).
 - 10. Enlarged view of the surface of the holotype (x 5).



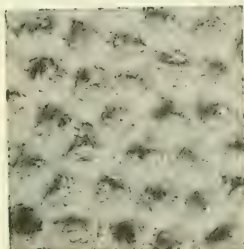
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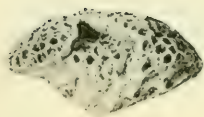
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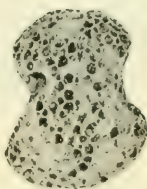
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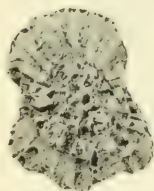
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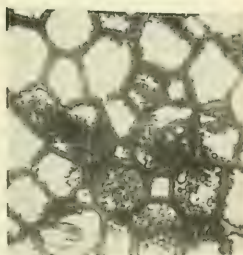
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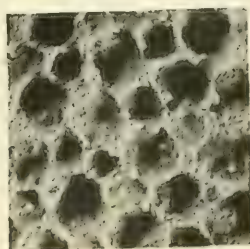
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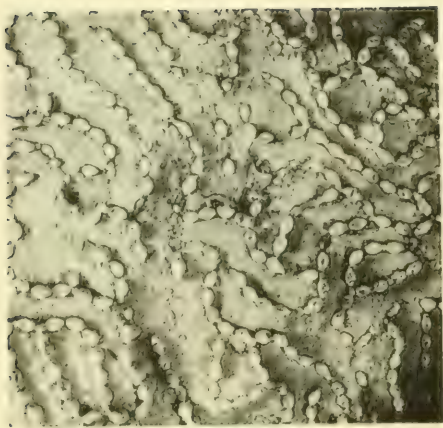
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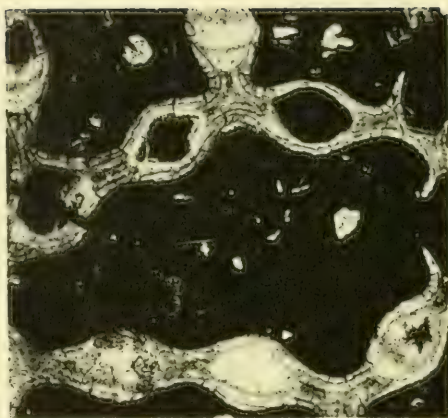
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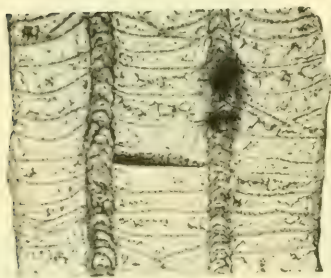
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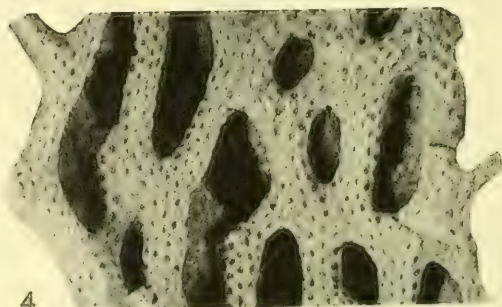
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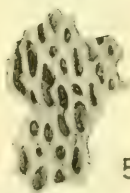
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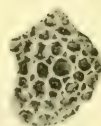
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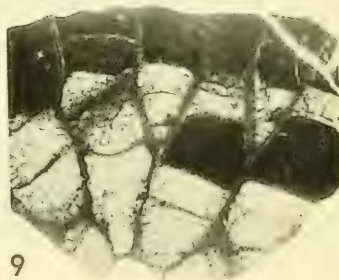
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PLATE XVIII

- Figs. 1-3. *Halysites catenularia brownsportensis* Amsden, n. var.
1. Upper surface of a partially etched corallum; holotype (x 1). Y.P.M. 17638. Locality 11-(36).
 2. Cross section of another specimen (x 5). Y.P.M. 17639. Locality 11-(36).
 3. Longitudinal section of another specimen showing large coral-lites and intervening tubes (x 5). Y.P.M. 17639. Locality 11-(36).
- Figs. 4, 5, 8. *Cladopora?* *reticulata* Hall.
4. View of a corallum (x 5). Y.P.M. 17649. Locality 11-(36).
 5. Same corallum (x 1).
 8. Section cut somewhat obliquely across the corallum shown in figs. 4-5 (x 5). In the lower left-hand portion this section is cut near the center; in the upper part it is near the outer edge of a branch.
- Figs. 6, 7, 9. *Favosites discoideus* (Roemer).
- 6-7. Top and bottom views of very small corallum (x 1). Y.P.M. 17629. Locality 19-(52).
 9. Longitudinal section of another corallum (x 5). Y.P.M. 17630. Locality 19-(52).

PLATE XIX

Figs. 1-6. *Cladopora? brownsportensis* Amsden, n. sp.

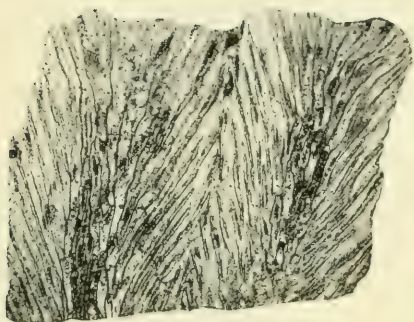
1. View of the holotype (x 1). Y.P.M. 17651. Locality 11-(36).
2. Enlarged view of a portion of the surface of another corallum (x 5). Y.P.M. 17652. Locality 11-(36).
3. Longitudinal section of two branches cut near the center of the corallum; cut from the corallum shown in fig. 2 (x 5).
4. Cross section cut from the holotype (x 5).
5. Cross section cut from the specimen shown in fig. 2; note the central core of thinner-walled, polygonal corallites (x 12).
6. Longitudinal section cut from the holotype (x 12).



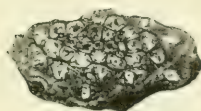
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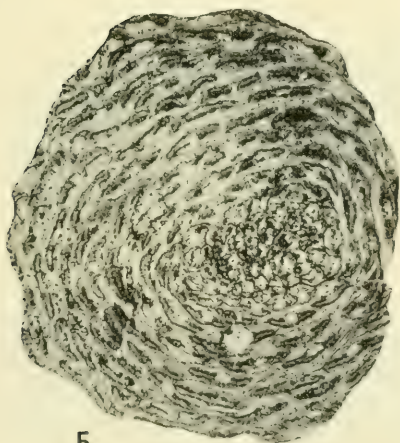
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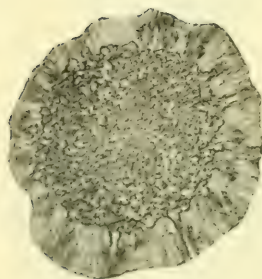
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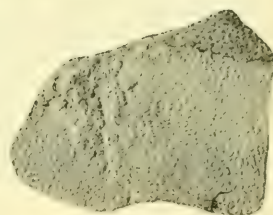
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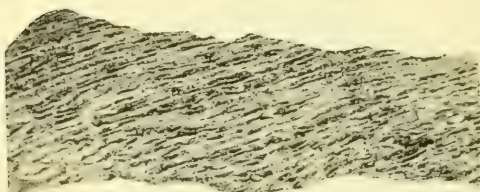
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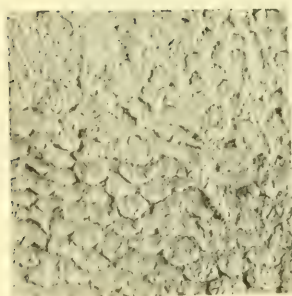
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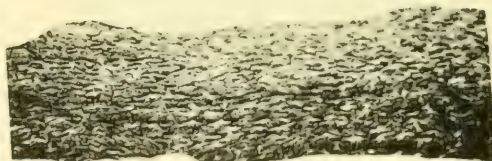
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PLATE XX

Figs. 1-2. *Dendropora? culmula* Amsden, n. sp.

1. Enlarged view of the holotype (x 5). Y.P.M. 17636. Locality 4-(6).
2. View of the same specimen (x 1).

Figs. 3-5. *Coenites verticillatus* (Winchell and Marcy).

3. Longitudinal section; note the sharp bend in corallites as they approach the surface (x 5). Y.P.M. 17650. Locality 16-(28).
4. Cross section cut from same (x 5).
5. Corallum of same before sectioning (x 1).

Figs. 6-9. *Platyaxum planostiolatum* (Foerste)

6. View of the upper surface of a portion of a corallum (x 1). Y.P.M. 17640. Locality 11-(36).
8. Enlarged view of the surface of same specimen (x 5).
7. Section of another specimen; this section cut approximately parallel to long axis of the tubes (x 5). Y.P.M. 17641. Locality 11-(36).
9. Cross section cut from the same corallum (x 5). This section was cut at right angles to the one shown in fig. 7.

PLATE XXI

- Figs. 1-6. *Striatopora gwenensis* Amsden, n. sp.
1. View of a corallum (x 1). Locality 9-(3).
 2. Holotype (x 1). Y.P.M. 17654. Locality 7-(11).
 - 3, 4. Another corallum (x 1), and an enlarged view of the surface (x 5). Y.P.M. 17655. Locality 0-7.
 - 5, 6. Longitudinal and cross sections cut from the same corallum (x 5). Y.P.M. 17656. Locality 9-(3).
- Figs. 7-11. *Planalveolites louisvillensis*? (Davis).
7. Section cut parallel to the upper surface of a corallum (x 5). Y.P.M. 17657. Locality 11-(36).
 8. View of the upper surface of the same specimen (x 1).
 9. Section cut at right angles to the long axis of the corallites (x 5).
 10. Section cut parallel to long axis of the corallites (x 5).
 11. Enlarged view of the upper surface (x 5). Figs. 7-11 are views of a single specimen; Y.P.M. 17657. Locality 11-(36).



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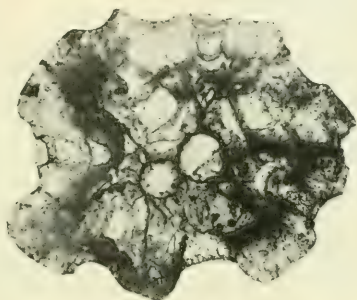
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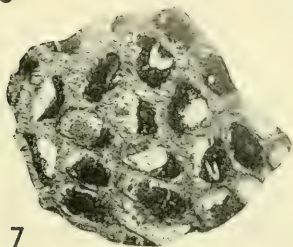
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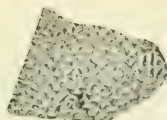
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PLATE XXIII

Figs. 1-3. *Pleurodictyum tennesseensis* Amsden, n. sp.

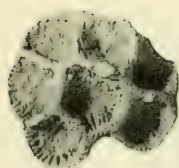
1-3. Upper, lateral, and bottom views of the holotype (x 1). Y.P.M. 17653. Locality 18-(2).

Figs. 4-9. *Thecia minor* Rominger.

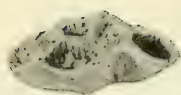
4, 5. Upper view of an incomplete corallum (x 1) and the same enlarged (x 5). Y.P.M. 17646. Locality 11-(36).

6, 9. Cross section (x 5) and the same section enlarged (x 10); this section cut from the specimen shown in fig. 4.

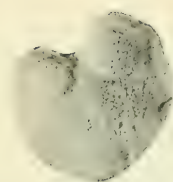
7, 8. Longitudinal section (x 5), and the same enlarged (x 10); this section cut from a different corallum. Y.P.M. 17647. Locality 11-(36).



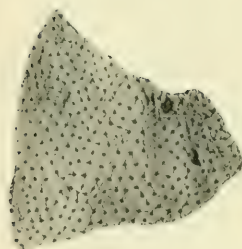
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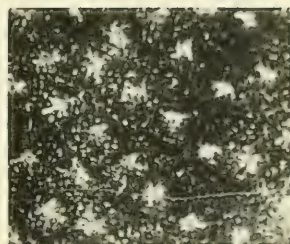
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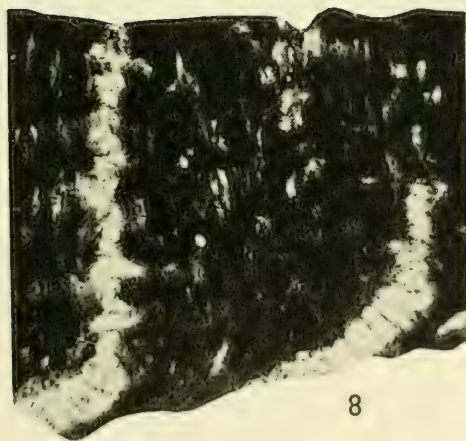
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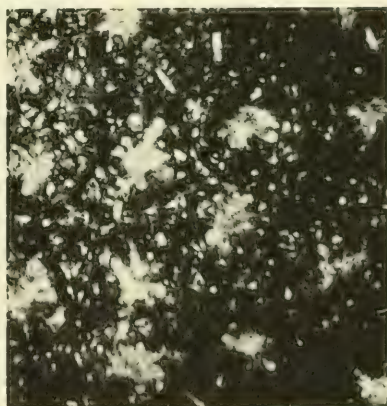
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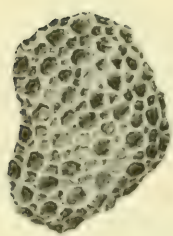
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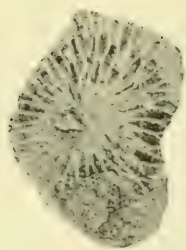
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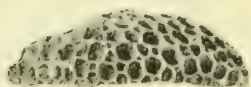
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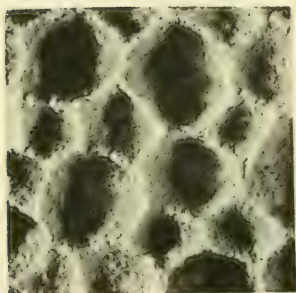
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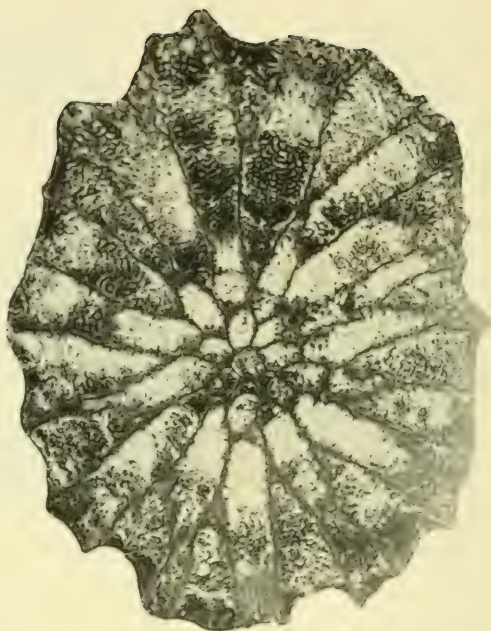
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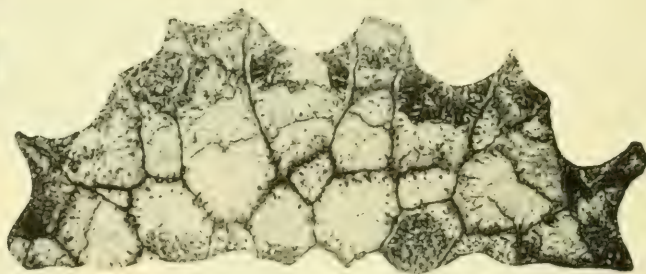
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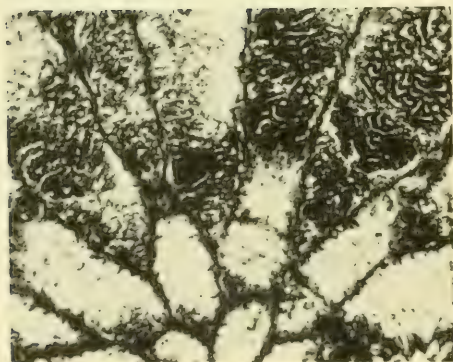
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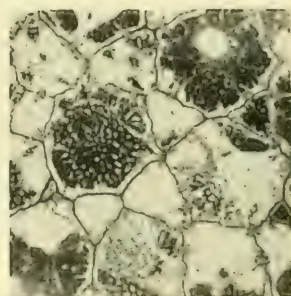
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PLATE XXIV

Figs. 1-8. *Emmonsia planobasalis* Amsden, n. sp.

- 1-3. Top, bottom, and lateral views of the holotype (x 1). Y.P.M. 17631. Locality 11-(36).
4. Enlarged view of the surface of this corallum (x 5).
5. Section cut parallel and close to the base of another corallum (x 5). Y.P.M. 17632. Locality 4-(14).
- 6, 8. Longitudinal and cross section cut from the holotype shown in figs. 1-3 (x 5).
7. Enlarged portion of the section shown in fig. 5 (x 10).

PLATE XXV

- Figs. 1-7. *Ditoecholasma fanninganum* (Safford).
 1. Oblique view of a calyx (x 2). Y.P.M. 17663. Locality 19-(19).
 2. Lateral view of another specimen (x 1). Y.P.M. 17662. Locality 4-(14).
 3. Lateral view of a different specimen (x 1). Y.P.M. 17661. Locality 4-(6).
 4, 5. Cross and longitudinal sections of the specimen shown in fig. 2 (x 3). The longitudinal section was cut approximately at the center of the corallite and shows the pseudocolumnella. The dark areas in both sections are mud-filled portions.
 6, 7. Two cross sections cut from the same specimen (x 3). Fig. 7 was cut 3 mm. from the base of the calyx, fig. 6 cut 8 mm. from the base of the calyx. Y.P.M. 17664. Locality 4-(6).
- Figs. 8-10. *Ditoecholasma acutiannulatum* Amsden, n. sp.
 9. Lateral view of the holotype (x 1). Y.P.M. 17665. Locality 11-(36).
 8, 10. Longitudinal and cross sections cut from the holotype (x 3). Longitudinal section cut near the center of the corallite and pseudocolumnella.
- Figs. 11-16. *Enterolasma waynense* (Safford).
 11. Calyx (x 2). Y.P.M. 17675. Locality 4-(6).
 12. Lateral view of a different specimen (x 1). Y.P.M. 17674. Locality 4-(14).
 13. Oblique view of the calyx of another specimen (x 2). Y.P.M. 17672. Locality 4-(14).
 14, 16. Cross and longitudinal sections cut from the same specimen (x 3). The upper part of the longitudinal sections shows the pseudocolumnella. Y.P.M. 17673. Locality 4-(14).
 15. Cross section cut 8 mm. from apex (x 3). Y.P.M. 17671. Locality 22-(15).
- Figs. 17-20. *Anisophyllum agassizi* Edwards and Haime.
 17. Lateral view of a corallite (x 1). Y.P.M. 17678. Locality 18-(2).
 18. Oblique view of the calyx of another specimen (x 2). Y.P.M. 17677. Locality 18-(2).
 19. Similar view of a different corallum (x 2). Part of calyx lip broken away. Y.P.M. 17676. Locality 18-(2).
 20. Lateral view of a corallite (x 1). Y.P.M. 17677. Locality 18-(2).



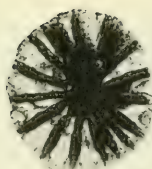
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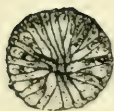
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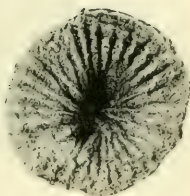
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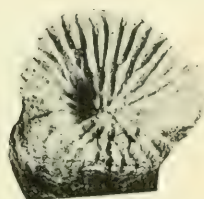
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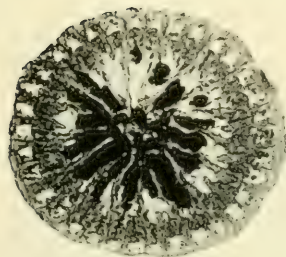
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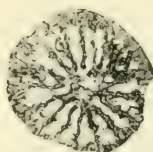
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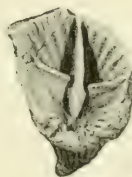
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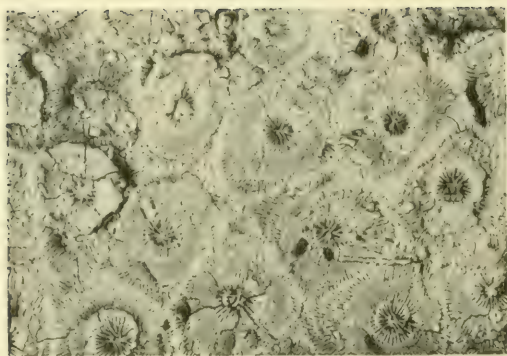
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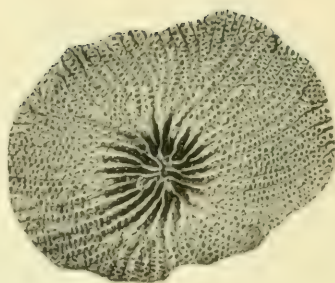
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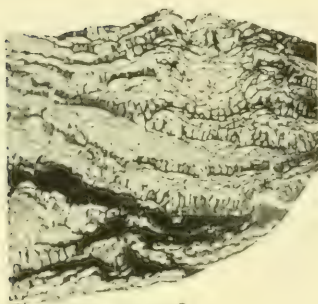
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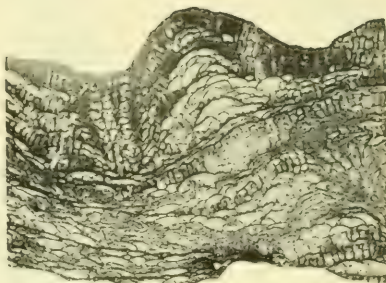
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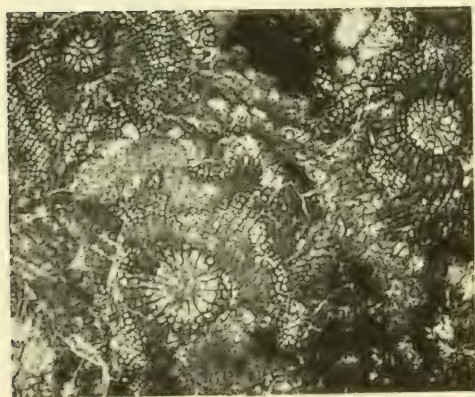
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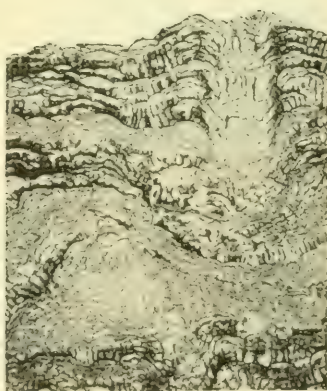
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PLATE XXVI

Figs. 1-6. *Arachnophyllum pentagonum* (Goldfuss).

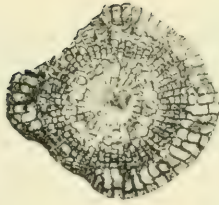
1. View of the upper surface of a corallum (x 1). Y.P.M. 17658. Locality 11-(36).
2. Enlarged view of a corallite of another specimen (x 3). Y.P.M. 17659. Locality 11-(36).
3. Longitudinal section (x 3). The crater-like depression shown at the top of this figure is the opening of a corallite. Y.P.M. 17660. Locality 11-(36).
4. Longitudinal section cut from specimen shown in fig. 2 (x 3). The two depressions at the top of this figure are the openings of two corallites.
- 5, 6. Cross and longitudinal sections (x 3). The longitudinal section cuts near the center of the corallite shown in the upper right hand corner. Sections shown in figs. 3, 5, 6 are cut from the same corallum.

PLATE XXVII

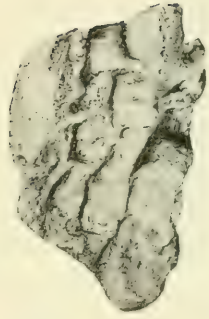
- Figs. 1-6. *Entelophyllum rugosum* (Smith).
1. Lateral view of a corallum (x 1). Y.P.M. 17698. Locality 11-(36).
 - 2, 5. Cross and longitudinal sections of a corallite (x 3). Both the sections were cut from the corallite shown in fig. 4. Y.P.M. 17699. Locality 11-(36).
 3. Lateral view of a small portion of a corallum (x 1). Y.P.M. 17700. Locality 11-(36).
 4. Calyx of a corallite viewed from above (x 2). Sections cut from this specimen shown in figs. 2, 5.
 6. Cross section of a corallite (x 3). This section cut from the corallum shown in fig. 3.
- Figs. 7-13. *Amplexus brownsportensis* Amsden, n. sp.
7. View of a calyx (x 2). Y.P.M. 17668. Locality 4-(9).
 8. Lateral view of the holotype (x 1). Y.P.M. 17666. Locality 4-(9).
 9. Tangential section (x 3). Cut very close to the outer edge of corallite. Y.P.M. 17667. Locality 18-(2).
 10. Cross section cut from the same specimen (x 3).
 11. Lateral view of a corallite (x 1). Y.P.M. 17669. Locality 4-(44).
 12. Lateral view of another corallite (x 1). Y.P.M. 17670. Locality 4-(9).
 13. Longitudinal section cut from the same specimen as the sections shown in figs. 9 and 10 (x 3).



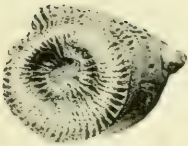
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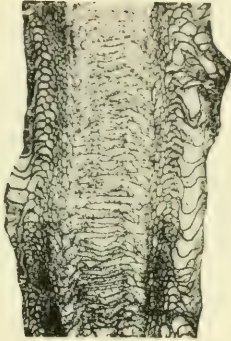
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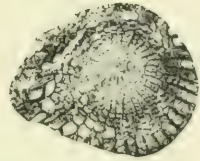
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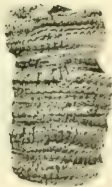
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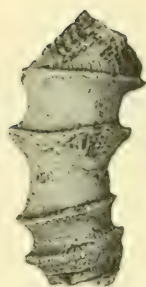
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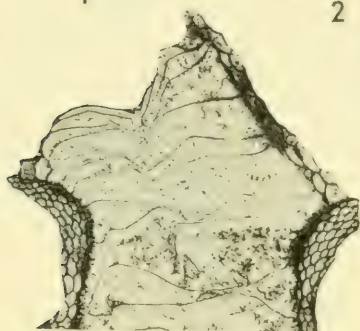
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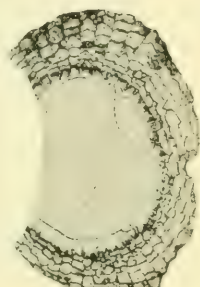
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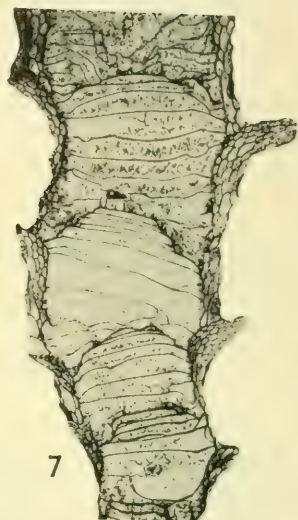
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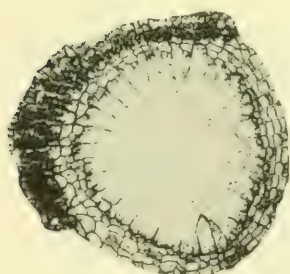
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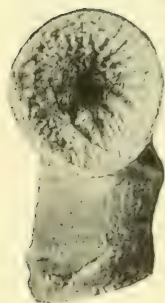
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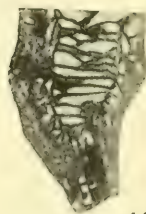
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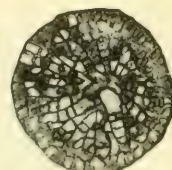
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PLATE XXVIII

Figs. 1-8. *Cyathophyllum cliftonense* Amsden, n. sp.

1. Lateral view of a corallite (x 1). Y.P.M. 17684. Locality 11-(36).
2. Lateral view of the holotype (x 1). Y.P.M. 17683. Locality 11-(36).
3. Lateral view of another specimen (x 1). Y.P.M. 17686. Locality 11-(36).
4. Lateral view of a smaller individual (x 1). Y.P.M. 17685. Locality 11-(36).
- 5, 8. Longitudinal and cross sections of the holotype (corallite shown in fig. 2) (x 3). The longitudinal section cut near the center and in the upper portion of the corallite.
- 6, 7. Cross and longitudinal sections (x 3), cut from the specimen shown in fig. 1. A portion of the left-hand side of the cross section is broken away.

Figs. 9-15. *Cyathophyllum angulare* Amsden, n. sp.

9. Lateral view of the holotype (x 1). Y.P.M. 17680. Locality 4-(9).
10. Lateral view of another specimen (x 1). Y.P.M. 17681. Locality 4-(9).
11. Lateral view of a much contorted specimen (x 1). Y.P.M. 17682. Locality 4-(9).
12. Calyx view of the holotype (x 3).
- 13, 14. Longitudinal and cross sections cut from the specimen shown in fig. 10 (x 3). Specimen partly silicified. The dark area on the periphery of the longitudinal section is dissepimental tissue.
15. Longitudinal section cut from holotype (x 3). This specimen is also partly silicified so that the dissepimentarium is somewhat obscured.

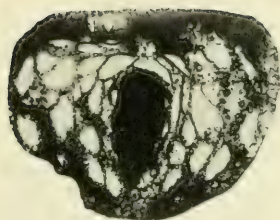
PLATE XXIX

Figs. 1-5. *Rhizophyllum tennesseense* (Roemer).

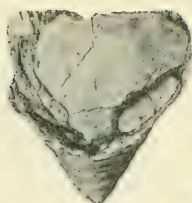
1. Cross section (x 3). Dark area in center of picture is mud filling in calyx. Y.P.M. 17697.
2. View of a small corallite with the operculum in place (x 2). Y.P.M. 17694. Locality 19-(19).
3. View of the calyx of a corallite without the operculum (x 1). Y.P.M. 17693. Locality 19-(19).
4. Longitudinal section cut near the center of the corallite (x 3). Dark area at upper left of picture is mud filling. Y.P.M. 17696. Locality 4-(14).
5. Lateral view (x 1). Y.P.M. 17695. Locality 19-(19).

Figs. 6-11. *Cystiphyllum lineatum*? Davis.

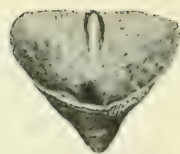
- 6, 11. Basal and lateral view of a corallite (x 1). The theca is partly broken away on this specimen. Y.P.M. 17703. Locality 11-(36).
7. Lateral view of a large individual (x 1). Y.P.M. 17704. Locality 11-(36).
8. Oblique view of the calyx of another specimen (x 1). Y.P.M. 17705. Locality 11-(36).
9. Longitudinal section (x 3). Y.P.M. 17701. Locality 11-(36).
10. Cross section of a larger individual (x 3). The portion shown extends from one edge of the corallite to the other edge. Y.P.M. 17702. Locality 11-(36).



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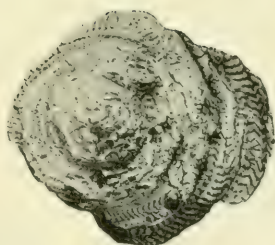
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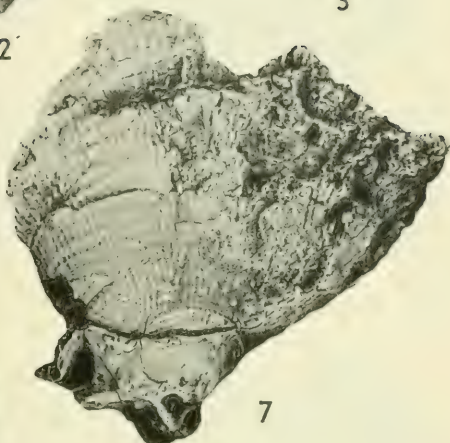
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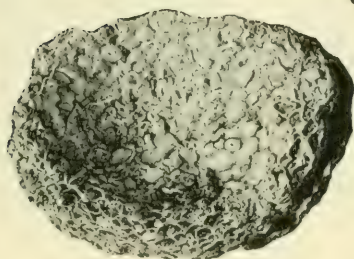
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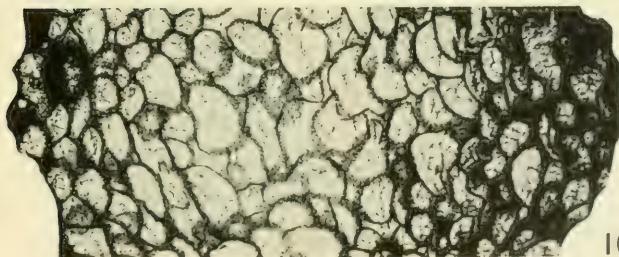
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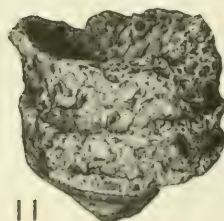
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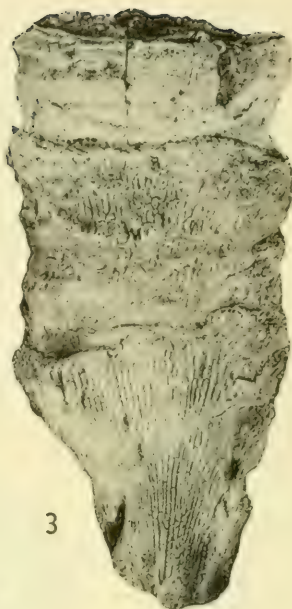
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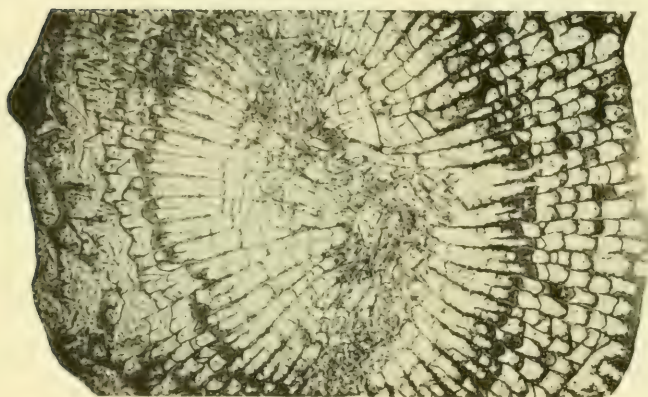
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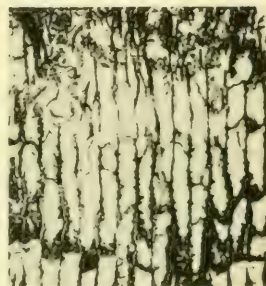
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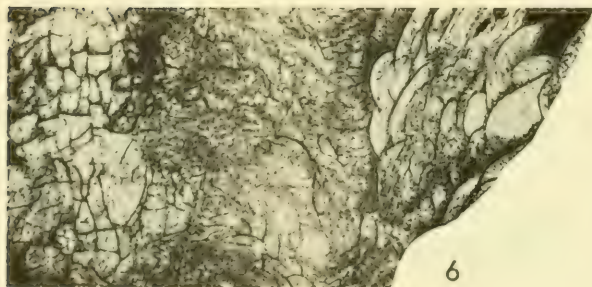
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PLATE XXX

Figs. 1-7. *Ptychophyllum?* *cliftonense* Amsden, n. sp.

1. Lateral view of a corallite (x 1). Y.P.M. 17692. Locality 16-(31).
2. Lateral view of another individual (x 1). Y.P.M. 17691. Locality 16-(31).
3. Lateral view of the holotype (x 1). Y.P.M. 17689. Locality 16-(31). The three specimens shown in figs. 1-3 are abraded.
- 4-6. Cross, tangential, and longitudinal sections cut from the holotype (x 3). Tangential section cut very close to the periphery of the corallite. The longitudinal section extends from the axial region (on the left hand side of the picture) to the periphery (on the right hand side of the picture).
7. Cross section cut from the specimen shown in fig. 1 (x 3). This section was cut approximately 9 mm. above the base.

PLATE XXXI

Figs. 1-5. *Naos brownsportensis* Amsden, n. sp.

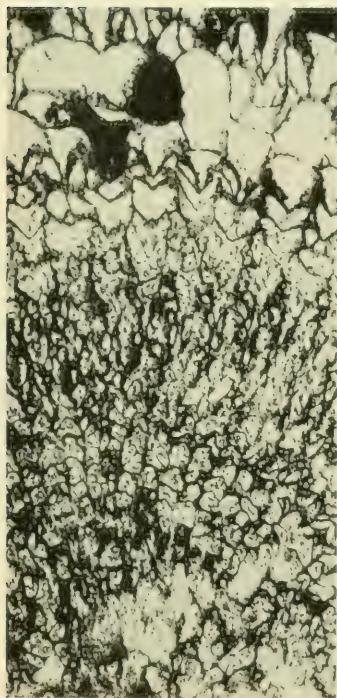
1. Lateral view of the holotype (x 1). Y.P.M. 17712. Locality 4-(6).
- 2, 3. Cross and longitudinal sections of the holotype (x 3). Cross section cut approximately 25 mm. from distal end. Longitudinal section cut near the center of the corallite.
4. Enlarged portion of the cross section shown in fig. 2 (x 7). Axial region at the lower part of the picture.
5. Tangential section cut near the outer edge of the holotype (x 3).



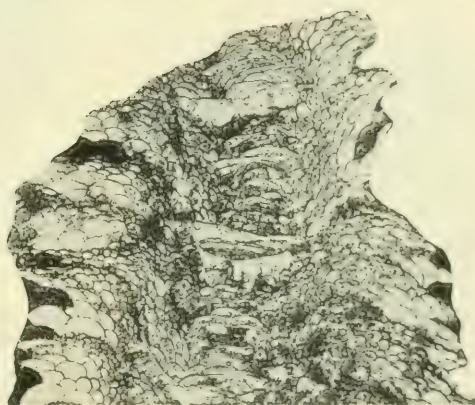
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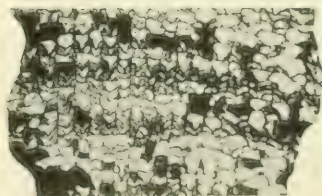
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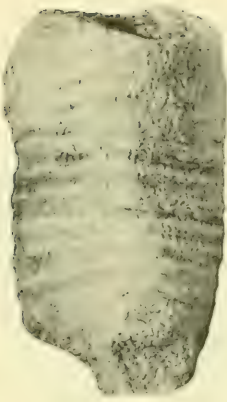
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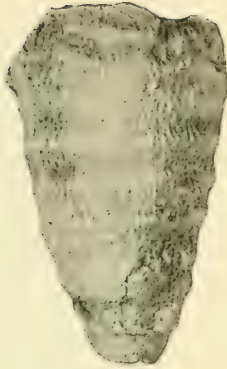
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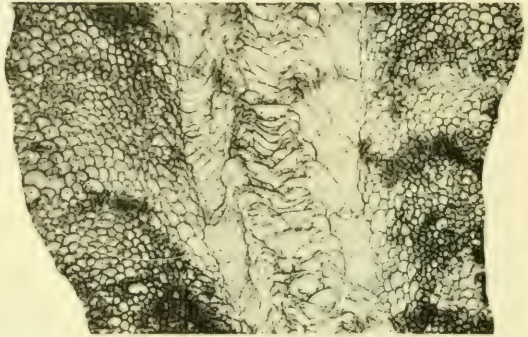
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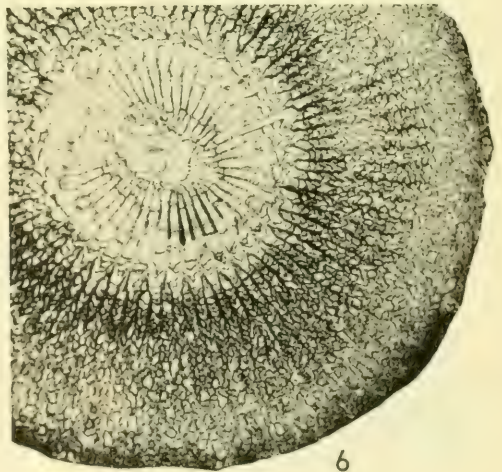
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PLATE XXXII

- Figs. 1-6. *Naos sewellensis* Amsden, n. sp. The specimens shown on this plate are somewhat larger than those shown on plate XXXIII but otherwise appear to be identical.
1. Lateral view of a corallite (x 1). Y.P.M. 17708. Locality 11-(56).
 2. Lateral view of another specimen (x 1). Y.P.M. 17707. Locality 11-(56).
 3. Lateral view of the holotype (x 1). Y.P.M. 17706. Locality 11-(56).
 4. Longitudinal section of the holotype (x 3). This section cut near the center of the corallite.
 5. Enlarged portion of the cross section shown in fig. 6 (x 7). The center of the corallite is at the lower edge of this figure. Cut from the specimen shown in fig. 1.
 6. Cross section of the specimen shown in fig. 1 (x 3). Fig. 5 and 6 are views of the same cross section.

PLATE XXXIII

Figs. 1-9. *Naos sewellensis* Amsden, n. sp.

1. Lateral view of a corallite (x 1). Y.P.M. 17709. Locality 11-(36).
2. Lateral view of another specimen (x 1). Y.P.M. 17710. Locality 11-(36).
- 3, 7. Longitudinal and tangential sections cut from the specimen shown in fig. 2 (x 3). Longitudinal section cut near the center of the corallite. Tangential section cut near the outer edge.
- 4, 5. Lateral and calyx views of another corallum (x 1). Y.P.M. 17711. Locality 11-(36).
6. Portion of a cross section cut from the holotype (x 7). This is an enlarged view of the same section shown in fig. 9.
8. Longitudinal section cut from the holotype (x 3).
9. Cross section cut from the holotype (x 3). An enlarged view of this section is shown in fig. 6.



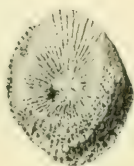
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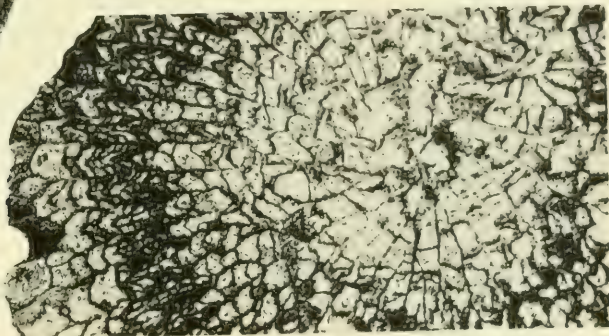
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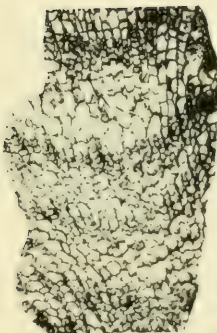
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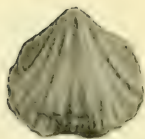
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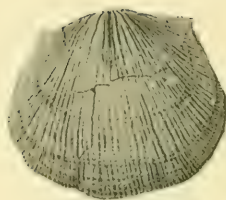
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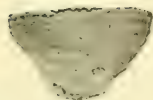
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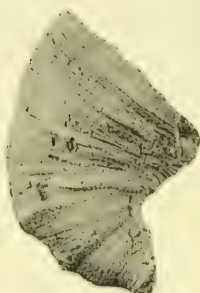
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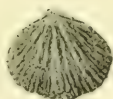
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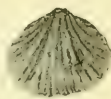
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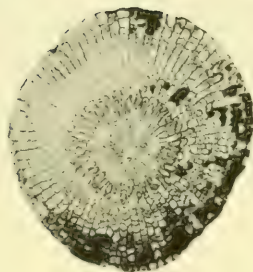
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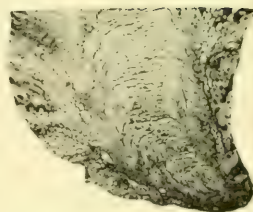
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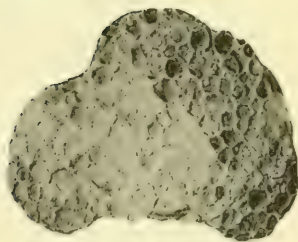
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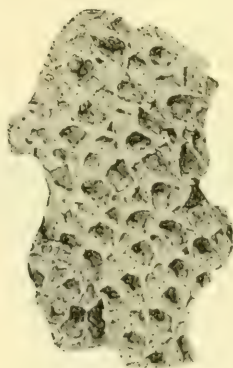
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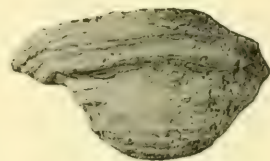
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PLATE XXXIV

- Figs. 1, 4. *Orthostrophia brownsportensis* Amsden, n. sp.
1. Lateral view of the holotype, enlarged (x 1.5). Y.P.M. 17851. Locality 18-(2).
4. Dorsal view of the holotype (x 1).
- Figs. 2, 3, 8-10. *Plectatrypa brownsportensis* Amsden, n. sp.
2, 3. Dorsal and ventral views of a paratype (x 2). Y.P.M. 17853. Locality 39-(135). Paratype.
8-10. Dorsal, ventral, and lateral views of the holotype (x 1). Y.P.M. 17852. Locality 39-(121).
- Figs. 5-7, 11, 12. *Cyathophyllum pegramense* (Foerste).
5, 6, 7. Lateral view of three different specimens (x 1). Y.P.M. 17856, 17857, 17858. All from locality 28-(74).
11, 12. Cross and longitudinal sections cut from the same specimen (x 1.5). Y.P.M. 17859. Locality 28-(74).
- Figs. 13, 15. *Favosites discoideus* (Roemer).
13. Surface view of a corallum (x 1). Y.P.M. 17855. Locality 28-(74).
15. Lateral view of the same specimen (x 1).
- Fig. 14. *Planalveolites lobelvillensis* Amsden, n. sp.
14. Surface view of the holotype (x 1). Y.P.M. 17854. Locality 38-(90).

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